THE GLASS INDUSTRY

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CERAMIC SOCIETY MEETS APRIL 7 IN TORONTO

The American Ceramic Society will hold its annual meeting at Toronto, Ontario, the week of April 7. All sessions will be held in the Royal York which, interestingly enough, is the largest hotel in the British Empire.

The program of technical papers covers the usual broad range of subjects and again meets a high standard of excellence. Those pertaining to the Glass Division sessions are listed and abstracted in paragraphs that follow.

Although the British Empire was not at war at the time the arrangements were made for this meeting, hostilities will in no way detract from the success of this Canadian invasion of ceramists. Rather, even to touch ever so slightly the fringe of the great war will be an experience to many and will heighten their interest. In a spirit of welcome, the Canadian Government has extended itself to care for the comfort and convenience of American Ceramists. Exhibitors may have their customs duties remitted, and Americans can take advantage of the 10 per cent differential in exchange by cashing their American currency at the Royal York Hotel.

The American Ceramic Society has made no announcement as yet concerning the order of the program, entertainment facilities and the like.

The Orton lecture will be given this year by Professor Wolsey G. Worcester, University of Saskatchewan. His title is "Orton, the Ceramist."

The Glass Division will hold its opening session on Tuesday morning, at 9:30 o'clock, the meeting room to be announced later. These will continue through Wednesday afternoon, all afternoon sessions starting at two o'clock. On Wednesday, a combined business meeting and get-to-gether luncheon is scheduled for 12:15 o'clock. Dr. Nelson W. Taylor, Pennsylvania State College, and chairman of the Division, will preside at all sessions.

The program includes a full and diversified selection of 22 papers, arranged by vice chairman W. R. Lester and his first lieutenant A. K. Lyle. The followipg letters and abstracts are arranged in the order in which they will be presented.

Specific Refraction of Glasses and Glass-forming Oxides. *By J. C. Young and A. N. Finn, National Bureau of Standards.*

Seven of the better known specific refraction ratios are examined for the comparative applicability to glass. It is shown by a comprehensive statistical treatment of available data (including many new data) that, of these ratios, only the Gladstone-Dale possesses to a satisfactory degree each of the following desirable features: (1) it varies linearly with chemical compositions and with the square of the wave-number of the incident light, (2) for a given composition and wave length of light it is substantially the same for both the vitreous and crystalline states, and (3) for the vitreous state it is independent of thermal history. Gladstone-Dale factors for 47 oxides as constituents of glass are given. These factors are shown to be related to the periodicity of the elements.

The Refractive Indices of Various Substances. *By G. W. Morey, Geophysical Laboratory.*

Progress in lens design is dependent upon the materials available to the designer. The range of refractive index and

The Royal York Hotel, Toronto, where the American Ceramic Society will hold its annual meeting next month.

dispersion in transparent materials, *i. e.*, isotropic crystals, and ordinary liquids is similar to that of glasses, with the exception of a few substances of notably different properties. The range of optical properties in crystals and liquids, including glasses, will be shown in slides.

The Relation of Density and Refractive Index to the Composition of Glass. *By Kuan-Han Sun and Alexander Silverman, University of Pittsburgh*

The density and refractive index and their relationship to the composition of glass is discussed. The subject is treated from the standpoint of additive properties based on composition both as to linear and collective or complex functions. Not only are these applied in the rapid checking of constancy of composition in practice, but from the standpoint of possible changes in properties through partial changes of individual components. There is the further possibility of tying constitution up with composition, so that a structural analysis may result. The article serves as a review of existing literature and elaborates the possibility of expansion upon published data.

Reducing the Reflection from Glass. *By C. Hawley Cartwright, Massachusetts Institute of Technology.*

Coating glass with a homogeneous film will reduce the reflection of green light to zero when the film satisfies two conditions: (1) the index of refraction is 1.23 (2) the optical thickness is 1370 A°. The first condition cannot be fulfilled exactly with any rugged film because it requires a material having an abnormally low index of refraction. However, even when this condition is satisfied only approximately with evaporated films of the metallic fluorides, a marked decrease in the reflection from glass is possible. The second requirement is of paramount importance and it is easy to fulfill experimentally. Although the reflectance is a minimum for only one wavelength, it is greatly reduced throughout the visible spectrum. Some of the metallic fluorides can be hardened so they will withstand weather and abrasion. The evaporation method limits the use of the metallic fluorides to relatively small surfaces.

Another method for reducing the reflection from glass consists of using a combination of two films so applied that the sum of the three reflection vectors add to zero. Such films may consist of TiO_2 and SiO_2, both of the correct thickness. These films can be applied in air and seem applicable for treating large surfaces of glass.

Rapid Methods for Detecting Small Amounts of Coloring Oxides in Some Batch Materials. *By F. W. Glaze and A. N. Finn, National Bureau of Standards.*

For certain purposes, such as the manufacture of optical glass, very small amounts of coloring oxides in the batch materials are disastrous. Although small in actual percentage, objectionable amounts of coloring oxides in potassium carbonate and arsenic oxide have recently been encountered. Methods for detecting about 0.001 per cent of nickel and cobalt oxides will be discussed.

Organization of Glass Research in Graduate Schools. An Address. *By Chairman Nelson W. Taylor.*

Nearly half of the research reports presented before the Glass Division since its organization in 1919 have originated in college or university laboratories. Most of the men trained by these researches are now in the glass industry. The advantages of a closer cooperation between industry and the schools in the training of graduate students in the basic sciences and in the methods of research in glass technology will be discussed.

TUESDAY AFTERNOON SESSION

The Effect of Certain Metallic Oxides on the Rate of Heat Penetration of Molten Glass. *By C. W. Parmelee, R. L. Shute, and A. E. Badger, Department of Ceramic Engineering, University of Illinois.*

The greater ease of melting colored or opaque glasses may be the result of two effects, namely: (1) a chemical action due to the fluxing power of colorant or opacifying agent, and (2) a physical action resulting from the increased absorption of heat radiation.

The first effect was studied by noting differences in the fining of glasses containing various additions of iron oxide. Tests on heat absorption were made by measuring the temperature gradient existing in various molten glasses under controlled conditions.

Melting Rate of Soda-Lime-Silica Glasses as Influenced by Composition, and Effect of Several Minor Constituents on Melting Rate of Such Glasses. *By J. C. Potts, Owens-Illinois Glass Company*

Using the disappearance of batch as a criterion of melting, a comparison of the rate of melting of twenty-six soda-lime-silica glass compositions has been made.

Then, using the composition 14 per cent Na_2O.12 per cent CaO.74 per cent SiO_2 ($+R_2O_3$) as a base glass. the effect of the substitution of small amounts of B_2O_3, BaO, SO_3, etc., upon the rate of melting was studied. The raw materials used were: Soda ash, Calcite limestone, Silica sand, Dehydrated borax, Barytes, Salt cake, Chili saltpeter, Ammonium sulfate and Fluorspar.

Reaction Between Metals and Molten Glass. *By A. E. Badger and B. Bard, University of Illinois.*

The reaction between metals (and a few non-metals) with a molten soda-lime-silica glass was observed by heating the materials contained in small crucibles in an atmosphere of hydrogen to prevent oxidation of the metal. Results of about twenty tests are presented.

An Isobar at 3000 Pounds in the System H_2O—Na_2O—CaO—SiO_2. *By G. W. Morey, Geophysical Laboratory.*

An informal discussion of the progress of work on this system with the presentation and explanation of some unexpected results.

Effect of Alumina on Devitrification of Soda-Dolomite Lime-Silica Glasses. *By W. B. Silverman, Owens-Illinois Glass Company*

The effect of the substitution of Al_2O_3 for Na_2O, CaO and MgO (in the ratio in which they occur in dolomite lime), and SiO_2 on the liquidus temperatures and phase relations for glasses lying within the composition range: Na_2O—12 to 16 per cent; CaO.MgO—0 to 20 per cent; SiO_2—63 to 78 per cent; and Al_2O_3—0 to 10 per cent, has been determined. The results on 116 individual determinations are given. Devitrite is the primary phase in but very few glasses. Several of the compositions studied could not be devitrified.

WEDNESDAY MORNING SESSION

Electrical Conductivity of Glass. *By A. E. Badger and J. F. White, University of Illinois.*

The electrical conductivity of glasses was measured at 400°C, using a frequency of 1000 cycles. Two series of glasses were measured, one consisting of soda-lime-silica glasses while in the other, various oxides were incorporated in the glass. Diagrams of the results of measurements are given.

Volume Resistivity of Glass. *By W. T. Gray, Corning Glass Works*

Resistivities of several glasses have been measured at temperatures above the softening point. Resistances were measured between platinum rod electrodes, with 60 cycle and 1000 cycle current. Values were converted to absolute resistivities by calibrating the cell with a standard electrolytic solution. The effect of the cell constant was minimized by varying the immersion depth of the electrodes.

X-Ray Study of Potash-Silica Glass. *By J. Biscoe, M. A. Druesne and B. E. Warren, Massachusetts Institute of Technology.*

X-ray diffraction studies of potash-silica glasses indicate a random network structure which is similar to that found in soda-silica glass. Each silicon is tetrahedrally bonded to four oxygens at a distance of about 1.63 A. Part of the oxy-

gens are bonded to two silicons and part only to one silicon. The potassium ions K^+ are randomly arranged in the network holes and surrounded on the average by about ten oxygen atoms.

X-Ray Study of Lime-Borate and Lime Phosphate Glasses. *By J. Biscoe, A. G. Pincus, and C. S. Smith, Jr., Massachusetts Institute of Technology.*

X-ray diffraction patterns of two lime phosphate glasses and one lime borate glass have been made. Radial distribution curves have been deduced from these patterns by means of a Fourier analysis. The peaks in these curves indicate interatomic distances that are in agreement with such distances in crystals.

In the lime phosphate glasses each phosphorous is tetrahedrally surrounded by four oxygens at a distance of about 1.58 A, and every oxygen atom is bonded to either one or two phosphorous atoms in such a way as to produce a continuous random network. The calcium atoms lie in the holes of this network and have about 7 oxygens as nearest neighbors.

The first peak in the lime borate distribution curve lies at about 1.48 A, which is to be compared with 1.36 and 1.53 A, the boron-oxygen distances in triangularly and tetrahedrally coordinated boron, respectively. From this it seems reasonable to suppose that some of the borons are surrounded by three and some by four oxygens.

Atomic Consideration of Immiscibility in Glass Systems. *By B. E. Warren and A. G. Pincus, Massachusetts Institute of Technology.*

An attempt is made to apply the results of crystal chemistry to the problem of immiscibility in glass systems. In a lime-silicate glass each silicon is tetrahedrally bonded to four oxygens, and part of the oxygens are bonded to two silicons and part only to one silicon. From the point of view of the Pauling rules the single bonded oxygens have an unsatisfied negative valence of one. The calcium ions Ca^{++} try to surround themselves by single bonded oxygens. Assuming that for stability each single bonded oxygen must bond to at least two calcium ions, and using known interatomic distances, and approximate minimum lime content for miscibility of 33 per cent is calculated. Similar considerations are applied to other systems including the ternary system Na_2O—B_2O_3—SiO_2. The results are in agreement with experiment within the limits of the approximations involved, and therefore seem to give some insight into the structural chemistry involved of miscibility.

Some Observations on the Thermal Expansion and Melting Point of Crystalline Boric Oxide. *By Donald Hubbard, National Bureau of Standards.*

Interferometer determinations of the thermal expansion on one sample of B_2O_3 crystals indicate a slight irregularity between 150 and 200°C, possibly attributable to surface adsorption of water. Disregarding this, the coefficient of linear expansion was about $15(10)^{-6}$ between room temperature and 400°C. Between 400 and 450°C the coefficient increased $6(10)^{-6}$. At 451°C the specimens collapsed abruptly, indicating a melting point. This temperature agrees with the 450°±2 reported by Kracek, Morey and Merwin as the melting point of the compound.

WEDNESDAY AFTERNOON SESSION

Modern Grecian Glass. *By Alexander Silverman, University of Pittsburgh.*

A paper devoted to the history of the chemical and glass syndicate of Greece, which probably has the largest capital investment of any organization of its type in the Near East. This corporation has employed artists who have developed unusual modern designs in glass, which are based on some of the ancient Egyptian, Roman, and Grecian designs. The talk will be illustrated with lantern slides.

Fracture Studies by Direct Photographic Enlargements. *By E. L. Hettinger, Willson Products, Inc.*

By making a series of enlargements of fractured pieces of glass and knowing one or two of the analyses, the difference in the composition of the glass may be checked, even though the refractive indices may be the same.

Durability of Optical Glass. *By Frank L. Jones, Mellon Institute.*

The paper will discuss the laboratory methods for measuring the durability of optical glass. It shows the relationship of laboratory results to exposure tests in both temperate and tropical climates and the use of these test results for guiding the development of new glasses.

Effect of Time and Temperature on Accelerated Chemical Durability Tests Made on Commercial Glass Bottles, Part II. *By F. R. Bacon and O. G. Burch, Owens-Illinois Glass Company.*

The effects of storage of solutions in glass bottles at room temperature are compared with the results of the various accelerated tests with corresponding solutions in the first paper of this series. The acid tests at room temperature are in good agreement with those at higher temperatures.

Relative resistances of glass bottles as shown by accelerated tests with water *roughly* parallel relative resistances appearing in room temperature storage of unbuffered, neutral materials, only if the various amounts of extractions are approximately the same at both temperatures. Under this cimcumstance, the correlation improves as the temperature of test approaches the temperature of storage.

The tendency of bottles to produce flakes or insoluble matter in alkaline solutions bears no direct relation to the amount of soluble material extracted by such solutions.

A Comparison of Titration and Conductivity Methods for Determining the Relative Solubility of Glass. *By E. H. Hamilton, Donald Hubbard and A. N. Finn, National Bureau of Standards.*

When the alkalinities of aqueous extracts of bottles (determined by direct titration) were plotted against the specific conductivities of the respective extracts, a linear relation was obtained for 10 out of 13 different bottles. "Back titers" of the filtered extracts (flakes removed) versus their conductivities gave a similar straight line with the exception of the three bottles already noted. The relation between "back titers" and conductivities of unfiltered extracts was variable. Results indicate the determination of only one property of extracts such as alkalinity or conductivity may lead to erroneous conclusions concerning relative "solubility."

CERAMIC CAMERA CLUB ACTIVITIES

The Second Ceramic Camera Club Salon will be held in Toronto, April 7 to 13, at the Royal York Hotel. Entry of four pictures may be submitted by any contributor. No entry fee is required, but an entry form must be mailed to J. Earl Frazier, Secretary-Treasurer, 436 East Beau Street, Washington, Pa., where it must be received prior to the closing date March 30th. Prints should also be mailed not later than this same date, and sent direct to the Toronto Camera Club (Ceramic Exhibit) Royal York Hotel.

As an added incentive to advance the art of photography among the members of the American Ceramic Society, the Frazier family in honor of Chauncey E. Frazier, President of Frazier-Simplex, will present a yearly award to the member exhibiting the outstanding photographic print at the Camera Club's Annual Salon.

This trophy for amateur photographers is a beautifully engraved plaque made of Steuben glass and designed by Frederick Carder, Art Director of the Steuben Division of the Corning Glass Works.

The presentation of the Chauncey E. Frazier Award will be made at the annual dinner meeting of the Ceramic Camera Club on Monday evening, April 8th, at 7 P.M., by Francis C. Flint, past president of the American Ceramic Society, who is serving as Chairman of the Award Committee for 1940. Other members of the committee are Charles D. Spencer of General Electric and Fred H. Rhead of Homer Laughlin.

BENJAMIN F. HAZLETON, JR.

Benjamin F. Hazleton, Jr., former vice president of the Owens-Illinois Glass Co., died in Toledo, Ohio, on February 3 as a result of a fall from a hotel window.

Mr. Hazleton has been identified with the glass container industry since 1908 when he joined the Berney-Bond Glass Co. Six years later he became president and general manager of this company. In 1920 he interested his firm in the manufacture of milk bottles, and this line of ware grew in importance with the company until it resulted in 1928 in its purchasing the Winslow Glass Co. of Columbus, O., which manufactured milk bottles. Two years later, these consolidated interests were acquired by Owens-Illinois, with which company Mr. Hazleton then became associated as vice-president. He held this office for nine consecutive years until his retirement a year ago. During his brilliant career of more than a quarter century, Mr. Hazleton won a host of friends throughout the glass container industry. Executives of the Owens-Illinois Glass Co. and close friends in other companies acted as pall bearers at the funeral held on February 6.

MRS. W. E. S. TURNER

Somewhat late in reaching America, the news has transpired of the death of Mrs. W. E. S. Turner on December 18. Mrs. Turner had not been in good health for some time and yet, only a few days before, she had been present at a tea given to the students of the Glass Technology Department of the University of Sheffield. Her passing comes as a great shock to her many friends in glass circles all over the world.

Mrs. Turner has been actively associated with her husband through the years in preparing and carrying through the programs at the University of Sheffield and in forwarding many of the glass promotions for which he has become noted the world over. She is known to American ceramists, having accompanied Professor Turner to this country on a number of his visits. At the funeral services, held on December 21, many floral tributes from glass manufacturers and scientific societies indicated the sense of the loss so many have felt in her passing.

Glass men throughout the United States join as one in expressing their deep sympathy to Professor Turner.

WALTER A. FORBES

Walter A. Forbes, chairman of the board of directors of Gunite Foundries, Inc., passed away on January 26. Apparently in good health, Mr. Forbes was celebrating his 70th birthday anniversary. Going to his bedroom for a brief rest, he died suddenly of a heart attack.

Mr. Forbes represented the third consecutive generation of his family in the Illinois iron industry. In 1854, his grandfather established the D. Forbes and Son iron works, which later was incorporated as Rockford Malleable Iron, and subsequently the Rockford Northwestern Malleable Iron Works. In 1931, this company and a subsidiary were brought together as Gunite Foundries, Inc. The late Mr. Forbes was president of these corporate enterprises from 1911 to 1931, when he retired from that office to become chairman of the board of directors. At the time of his death he was also a director of the Mattison Machine Works. He was instrumental in founding several of Rockford's outstanding industries.

JOHN J. FASMER

Mr. John J. Fasmer, former general sales manager of the Stephens-Adamson Manufacturing Co., Aurora, Ill., died suddenly on February 3. Mr. Fasmer had been in active service with the Stephens-Adamson Co. since its organization in 1901; as superintendent of the main factory at Aurora until 1909, as manager of the St. Louis Sales-engineering office to 1931, and more recently as General Sales Manager at Aurora. A few months ago, when illness limited his activity, he took charge of special promotional projects and was engaged in these duties when death overtook him.

ARTHUR J. BENNETT

Arthur J. Bennett, president of the Cambridge Glass Co., Cambridge, Ohio, died suddenly February 19 at his home in Cambridge.

Born January 18, 1866 in London, England, Mr. Bennett came to this country at the age of sixteen. He spent some years as a buyer for Jordan Marsh Co. in Boston. Leaving the buying field, Mr. Bennett associated himself with B. F. Hunt and Sons, importers of china and glassware in New York. About 1901, the National Glass Co. interested Mr. Bennett in joining its sales staff, and he was placed in charge of sales for the new plant at Cambridge. He soon became its manager. When the National Glass Co. went into receivership in 1907, Mr. Bennett acquired the property, which then became the Cambridge Glass Co. He served continuously as president of the Cambridge Glass Co. until his death.

OPTICAL SOCIETY MEETS

The Optical Society of America held a joint meeting with the American Physical Society and the Inter-Society Color Council on Friday, February 23, at Columbia University, New York. A symposium on "Optical Methods for the Study of Molecular Structure" was presented, the invited papers being: The X-Ray Diffraction Method, by B. E. Warren, Massachusetts Institute of Technology; The Electronic Diffraction Method, by Louis R. Maxwell, U. S. Department of Agriculture; The Band Structure Method, by R. Bowling Barnes, The American Cyanimid Co; and the Raman Spectra Method, by George M. Murphy, Yale University.

Following the joint symposium, the Optical Society met separately in a two day session. Among the papers of interest to glass technologists was The Total Emissivity of Various Materials, by B. T. Barnes, E. O. Adams and W. E. Forsythe, of the Nela Park Laboratories of General Electric Co. The emissivity at 100° C was given for various metal, glass and pressed-carbon samples and for metal sheets coated with various radiator paints. Most metal samples tarnished when held at 300° C. Only carbon, quartz and glass samples could be held to 500° C without surface changes. The emissivities of the samples are given below.

	100° C	320° C	500° C
Average for four carbon samples	0.76	0.76	0.71
Fused quartz	.78	.80	.75
Corex-D glass	.80	.80	.76
Nonex glass	.82	.82	.78

BUCK GLASS CO. MODERNIZES BATCH HANDLING

Mixed batch now handled in unit containers from mixer to doghouse, the installation providing a very interesting application of standardized tramrail equipment in a single-tank plant.

At the Buck Glass Company plant, in Baltimore, glass is melted in a side-port, oil-fired regenerative tank and, after passing through the feeders and forming machines at the front end of the furnace, is transferred to the annealing lehrs which parallel the tank and finally deliver the finished bottles in the inspection and packing area adjacent to the melting end of the furnace. In other words, the lehrs are located at each side of the tank and form an effective barrier to the movement of materials to the tank from the side.

The batch material storage and preparation house is located adjacent to the side of the tank building, the mixer itself being almost on a line with the rear end of the tank. Under these conditions the transportation of mixed batch to the furnace has always been quite a problem. The use of carts or trucks on the factory floor has not been feasible, since their movement would interfere with the activities in the inspection and packing area behind the tank. Furthermore, adequate storage of batch would be difficult; some method of elevation would still be required at the tank; and the dust hazard would be serious.

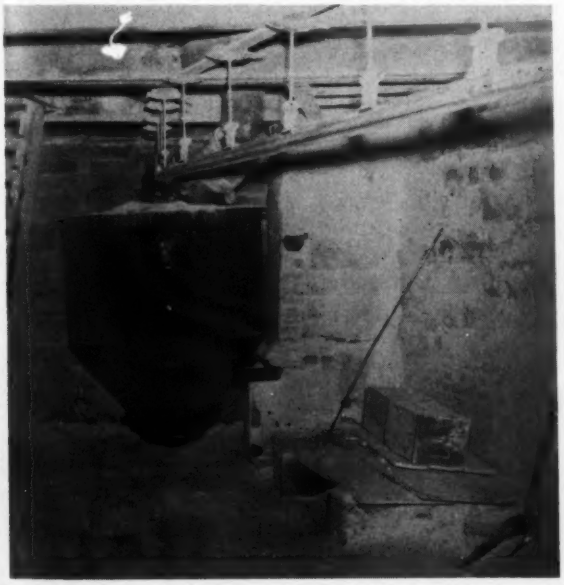


Fig. 1. At the Buck Glass Co. mixed batch is discharged through a chute from the mixer to a batch bucket carried on a tramrail in a basement passageway.

For a period of years, therefore, mixed batch was handled by an overhead belt conveyor which entered the tank building near the mixer, passed above the lehrs at the right side of the tank and finally discharged into a storage tank located above and to the rear of the doghouse. Batch was fed to the doghouse through a chute having an adjustable shut-off gate. The operation of this system was quite satisfactory, but its shortcomings were also quite obvious, especially as the standards for glass quality improved. In the first place, the storage capacity was inadequate; second, there was definite segregation of batch materials between the mixer and the doghouse; and finally, there was always a considerable amount of dusting while the conveyor was in operation.

The Buck Glass Company, though small in size, has helped to maintain its position in the container industry through a continuing policy of product betterment and plant improvement. This forward-looking policy has led to the initiation of some quite out-of-the-ordinary developments at Buck Glass, under the supervision of Vice-President R. A. Blunt, the most recent being the new mixed batch handling system with which this article is particularly concerned. The new system has now been in operation for several months and seems to have completely eliminated the faults that were more-or-less inherent in the former equipment.

As will be seen from the accompanying illustrations, the new system utilizes unit containers or "batch buckets," each bucket holding a single mixer load. From the

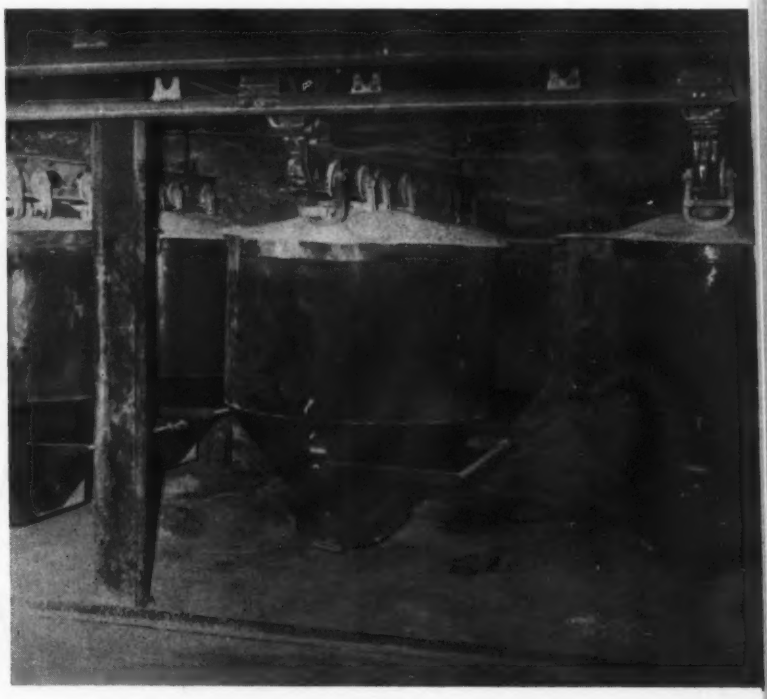


Fig. 2. This view shows the tramrail arrangements for storing loaded batch buckets in the basement at the Buck Glass Co. At the top can be seen the rails over which the transfer bridge passes through the basement to the storage positions.

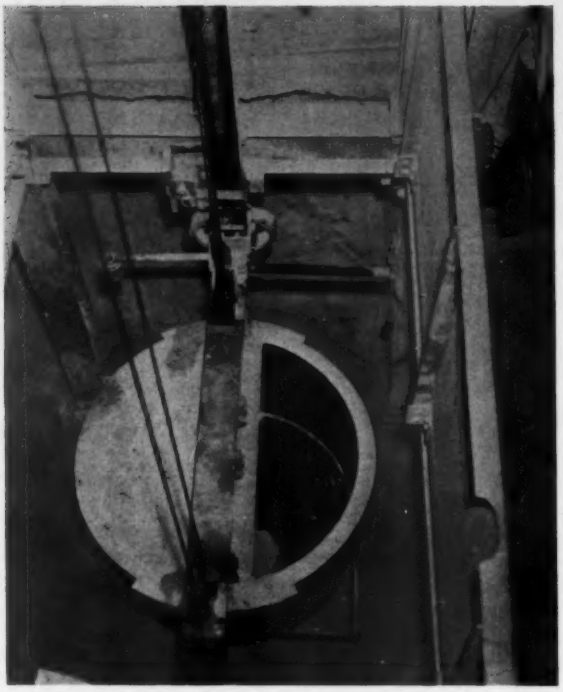


Fig. 3. As one looks down through the 5 by 8 ft. opening in the factory floor, the hoisting section of tramrail can be seen at the bottom of its travel with an empty batch bucket.

time the bucket is filled at the mixer station until it is finally discharged into the batch feeder at the tank, the mixed batch remains undisturbed, thus removing practically all difficulties arising from segregation. Buckets are filled in the mixing room, filled buckets are stored in the basement, and a power-operated hoist raises the filled buckets to the tank level when required. The buckets are pushed or pulled from point to point manually over a simple sturdy tramrail system, both the tramrail system and the hoist having been furnished by the Cleveland Crane & Engineering Company. The basement storage facilities are particularly effective in reducing the interference with other plant activities, as well as in elimination of the dust hazard.

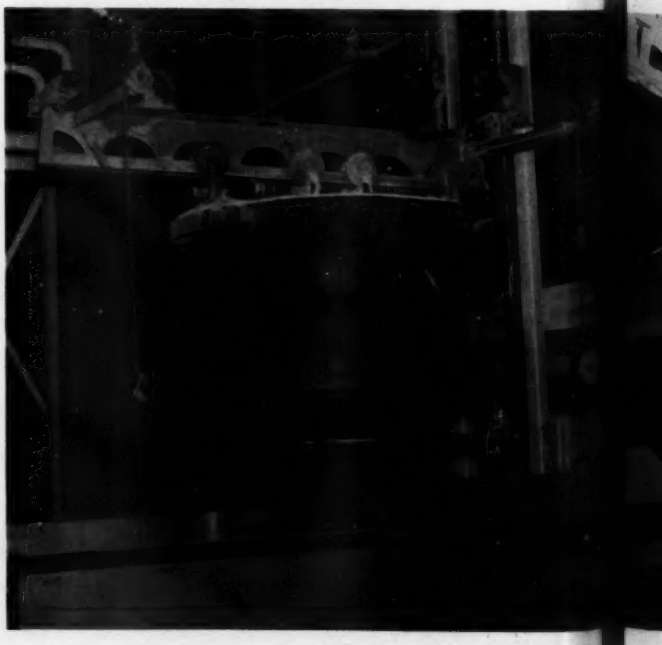
From a position beneath the mixing room a passageway extends some 20 or 25 ft. toward the tank, passing beneath the lehrs on that side of the tank and leading into the main basement section. In Fig. 1 the mixer end of this passageway is shown with a batch can on the tramrail in loading position below the mixer discharge spout. Between the lehr and the melting tank a rectangular opening in the factory floor has been made through which the hoist tramrail section can rise and, in its lower position, this hoist section lines up with the tramrail shown in Fig. 1.

If the filled batch can is to be stored, however, it is pulled on over the hoist section below the floor opening to a transfer bridge section which runs through the basement on a couple of parallel rails. These rails can be seen at the top of Fig. 2 and, at right angles to these rails, stationary sections of tramrail are located at intervals. The filled batch buckets for storage are carried through the basement on the transfer bridge section and pushed off upon any available stationary tramrail section, where they remain until needed, as shown in Fig. 2. The transfer bridge passes down the basement a distance of about 60 ft. and there are ten storage stations for filled batch cans en route. With these arrangements storage capacity for mixed batch equivalent to more than one-half day's requirements at maximum production rates are provided. Furthermore, the stored material is located in the plant basement where it interferes with no other plant activities.

It is evident that a filled batch bucket can be elevated to the tank position either from storage or direct from the mixer with equal facility, thus providing a flexible arrangement. Each batch bucket has an outside diameter of 4 ft. and a capacity of 36 cu. ft., equivalent to between 3,000 and 4,000 lbs. of batch. The bucket hangs from the tramrail on four pairs of wheels and has an overall height of 5 ft. from the rail to the bottom of the discharge gate.

The lift or hoist section of tramrail is about 7 ft. long and is supported by two pairs of cables, one pair near either end, the cables being wound on a motor-operated winch drum. The hoist section is guided at one end by a vertical rail and is stopped automatically in alignment with the stationary tramrail sections at the limits of its upward or downward movement. The hoist motor is started by a push-button control and may also be stopped at any point in the hoist travel. The total lift of the hoist is 23 ft., the hoist rising at a speed of 28 ft. per minute. The total hoist capacity is approximately three

Fig. 4. Here the hoist section is rising with a loaded bucket through the railing-enclosed floor opening. Note the close proximity of the lehr housing in the rear and the oil valve mechanism casing at the lower right.



tons and the mechanism is driven by means of a 7½ hp. motor.

Fig 3 is a view looking down through the opening in the factory floor and shows the hoist section of the tramrail at the bottom point of its travel with an empty batch bucket which has been lowered from the upper level. The lifting cables can be seen here, together with the guide rail, which rises in the background. The floor opening is encircled by a sheet-metal railing which can also be seen at the lower left in Fig. 4. In Fig. 4 the hoist section has just risen through the floor opening carrying a loaded batch bucket toward the upper tramrail level.

It will be noticed that the only factory floor area utilized by this entire batch handling system is the 5-ft. by 8-ft. section encompassed by the sheet-metal railing. Furthermore, this little area is tucked away in a corner between the lehr housing, which appears in the background in Fig. 4, and the casing which surrounds the fuel oil valve mechanism for the tank, which appears in the right foreground in the same picture.

In Fig. 5 the hoist section has reached the upper limit of its travel and has stopped automatically in line with the upper section of tramrail at the rear of the tank. In this position the bucket can be reached with a hook from the charging platform and drawn toward the charging position at the furnace. Fig. 6 is another view of the upper tramrail line with the empty hoist section in alignment at the farther end in readiness to receive an empty batch bucket from the furnace. The method of tramrail support is indicated in this view, as well as the comparative ease with which the rail can be curved to meet the proper position at the doghouse. This latter point is of considerable importance in most plants, since the exact location of the doghouse is often moved through a substantial distance when the furnace is rebuilt after a campaign.

The batch is finally charged into the furnace through a single type H-A batch feeder furnished by the Simpson Foundry & Machine Co. The feeder is shown in operating position at the doghouse (front cover), with the batch bucket in position and the batch flowing through the bucket gate into the small feeder hopper. There is a sufficient length of tramrail above the charging platform to accommodate two batch buckets, that is, one in addition to the bucket at the feeder position. The operation of the hoist is rapid enough, however, that an empty bucket can be returned to the basement and replaced by a full bucket without delay in the tank charging operation.

The Buck Glass Co. batch-handling installation is not, of course, important because of its size, but it does point out a method by which one type of standardized materials handling equipment can be applied to solve the batch handling problems in a small plant. The system reduces segregation in the mixed batch, provides ample storage, tends to eliminate the dust hazard, and accomplishes these advantages without an increase in the labor required. Furthermore, the Buck Glass installation is operated with very little intereference to other plant activities and an accomplishment along this line, with modifications adapting the system to local situations, should be possible in most small plants.

Fig. 5. When the hoist section reaches the top of its travel it aligns with the upper stationary tramrail section as shown here.

Fig. 6. The upper tramrail section leads from the hoisting position to the charging end of the tank. The empty hoist section appears at the farther end of the tramrail.

GLASSMEN HONORED AS MODERN PIONEERS

In recognition of their services as modern Pioneers in Industry, seven glassmen were among the recipients of awards given by the National Association of Manufacturers, at ceremonies held in various cities through the country during February, in observance of the 150th anniversary of the United States Patent System.

The Modern Pioneer award has been made by the National Association of Manufacturers to citizens who have made notable contributions to the development of industry, science and public welfare. The awards were based on nominations sent to an independent committee composed of eminent scientists and headed by Karl T. Compton, President of the Massachusetts Institute of Technology.

The patent system, established in 1790, has provided a stimulus not only to the inventor and research worker, but also to the manufacturer and investor. It typifies perhaps more dramatically than any other American institution, the American principle of reward for individual initiative.

The following are the glassmen honored by the Association, and a summary of their more outstanding accomplishments in this industry.

Karl E. Peiler

Karl E. Peiler is vice president of the Hartford-Empire Co. He is named as the sole inventor in 147 United States Patents relating to glass, in addition to 23 others in which he is named co-inventor. In foreign countries, he is sole or coinventor in 255 patents in 30 countries. By means of these inventions and patents, Mr. Peiler has revolutionized the entire glass container industry.

Mr. Peiler first came in contact with the glass industry in 1910 when he was employed to assist the late William A. Lorenz, a consulting engineer retained by the Beech-Nut Packing Co. to investigate certain difficulties it had encountered with its glassware. Mr. Peiler, through his studies, discovered there was a pressing need for improved methods and machinery in the glassware industry, and the mere number of his patents suggest how active he became in filling that need.

Among the most important of the Peiler patents are 1,573,742, 1,655,391, and 2,073,572 which cover basic inventions relating to the feeding of molten glass to molds for the manufacture of bottles; that is, taking melted glass batch from a large supply and parcelling it out in individual charges for delivery to the molds. These and other Peiler inventions have resulted in a glass feeding system (known as the "suspended charge" feeding system) which has revolutionized glass container manufacture. Other Peiler patents relate to electric clutches, refractories, and equipment for melting and clearing resinous gums.

Eugene C. Sullivan

Eugene C. Sullivan is vice chairman of the board of directors and director of research at the Corning Glass Works. Largely because of the laboratory research at Corning, leadership in glass technology has come to the United States.

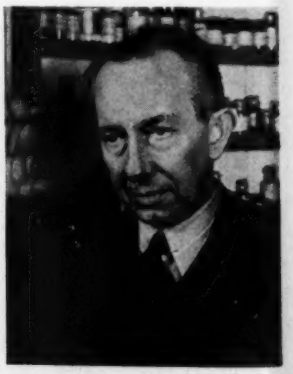
Mr. Sullivan organized and for a number of years directed the research laboratories at Corning. Collaborating with physicists and psychologists, he caused railroad signal colored glass to be produced of a standardized hue, and these afford maximum light transmission, distinctiveness and uniformity of color. He originated the low-expansion, heat-resisting glass for railroad lantern globes, and with Mr. Taylor developed "Pyrex." He developed special soda magnesia lime glasses for automatic production of bulbs; special glasses for filtering out or for transmitting specific bands of the spectrum, from X-rays through the ultra-violet and visible into the infra-red. Supervised the melting of each of the 335 glasses currently produced in Corning plants (with 60,000 others in reserve). Contributed to the working of suitable metals and alloys for contact with hot glass under various conditions. Developed special glass refractories for tank blocks. Received, jointly with W. C. Taylor, the Howard N. Potts Medal of the Franklin Institute 1928. Received the Perkin Medal "for Distinguished Services to Applied Chemistry."

Edgar D. Tillyer

Edgar D. Tillyer, director of the research laboratories, American Optical Co., is best known for his development of the Tillyer lens which corrects marginal astigmatic and focal errors. Many other contributions to the arts and sciences are found among his 125 patents. He has

Karl E. Peiler

Eugene C. Sullivan



Edgar D. Tillyer

Wilbur B. Rayton

Games Slayter

William C. Taylor

Edward Bausch

developed glass compositions for lenses which absorb ultra-violet and infra-red rays. His analysis of deep-curve aviation lenses resulted in elimination of prismatic displacement, providing greater accuracy for army and navy gunners. He assisted in the development of the Lensometer, which checks the accuracy of lenses, and invented mono-centric and other bifocal lenses which reduce image displacement. Mr. Tillyer's life has been devoted to not only the field of optics, but astronomy, fire control, radio, motion pictures and television.

Wilbur B. Rayton

Wilbur B. Rayton is head of the scientific bureau of the Bausch & Lomb Optical Co. His patent 1,715,784 issue in 1929, covers a system of ophthalmic lenses corrected for marginal astigmatism, and having toric surfaces characterized by basic curves which are common for lenses of several powers enabling the dispensing optician to dispense prescribed lenses of any desired power from a minimum number of semi-finished stock blanks, thereby lessening the cost of such lenses and facilitating their manufacture. The system of lenses covered by this patent was designed to give the wearer of glasses the nearest possible approach to the vision enjoyed by the normal eye, by means of the elimination of marginal astigmatism.

Games Slayter

Games Slayter is vice president in charge of research of the Owens-Corning Fiberglas Corp. He invented the methods and processes which made fibrous glass comercially important. Employed by the Owens-Illinois Glass Co. in 1931 as a consulting engineer for the purpose of finding new products and new uses for glass, he soon conceived the idea of attenuating a series of fine glass streams by means of steam. He finally accomplished this by directing steam jets at angles converging in such a manner that when the steam impinged upon the glass streams, it yanked the glass into fine long filaments. The basic "steam blowing" patent No. 2,133,236 was issued to Slayter and his assistant, John H. Thomas.

Having developed glass fibres, it was but natural to seek to weave these fibres into cloth. Previous attempts in this direction had resulted in a cloth that could not be folded without splitting; for the glass was too brittle. Mr. Slayter conceived the idea of investigating the ratio of yarn diameter to fibre diameter, as well as critical fibre diameters, and here he found the solution of the problem. Patent 2,133,238 covers the method of making staple fibre yarns by a steam blowing process. This basic method has been improved by what is known as the "continuous" method, in which glass is melted in a platinum trough having a multiplicity of fine holes along the bottom, through which the molten glass flows. Control of the temperature of the glass as it emerges through these orifices is basic and the entire method is covered by patents pending.

William C. Taylor

William C. Taylor is director of glass technology at the Corning Glass Works. His development, with Dr. E. C. Sullivan of the Pyrex type of glass, with its low coefficient of expansion and high chemical resistance, has resulted in establishing in this country a new and separate branch of the glass industry. Previous to the development of Pyrex, products made of this type of glass were made only in foreign countries, and the World War shut off these importations completely. Mr. Taylor's work brought the manufacture of heat resistant glass to the United States. The more recent continuation of this development has resulted in a still superior quartz-like glass, which gives promise of extensive utilization in many fields of science, as well as for industrial and household purposes.

Edward Bausch

Edward Bausch, chairman of the board of directors, Bausch & Lomb Optical Co. invented the Contour Measuring Projector, and thereby gave to the machine tool industry an instrument for the quick solution of its measurement and comparison problems. His patent 1,934,582 issued in 1933, describes an optical instrument which affords a means of accurately measuring, gaging and inspecting screws, gears, pinions and other objects by projecting an image or profile of the object on a screen. A series of objective lenses are provided, each lens designed to project an image having a different fixed magnification. By merely choosing one of a series of lenses of rated power a definite magnification is secured without manipulation. The image is neither inverted or reverted. A photographic plate may be substituted for the screen. A transparent horizontal stage is a feature of the instrument and other accessories are provided for convenience in handling a great variety of objects.

REDUCING BLOCK EROSION AT THE GLASS LEVEL

By R. L. SHUTE

A large part of the heat input to a glass furnace is carried away by the flue gases or lost through radiation. As these losses are fairly constant after the furnace is at melting temperature, any increase in the tonnage melted, over the rated capacity of the furnace, represents an increase in production with comparatively small fuel consumption.

In order to take advantage of this possibility of lowering melting costs, many furnaces are operated at tonnages much larger than those for which they were originally designed. This practice of overloading has subjected them to more rapid deterioration and has served to bring out more clearly the weaker points in their construction. As these weaknesses became more apparent, better refractories have been developed and other means employed to prolong the life of the furnace.

One point of severe attack is to be found in the tank wall blocks at the glass line, where a combination of intense heat, corrosive liquids and convection currents bring about rapid erosion of the refractories.

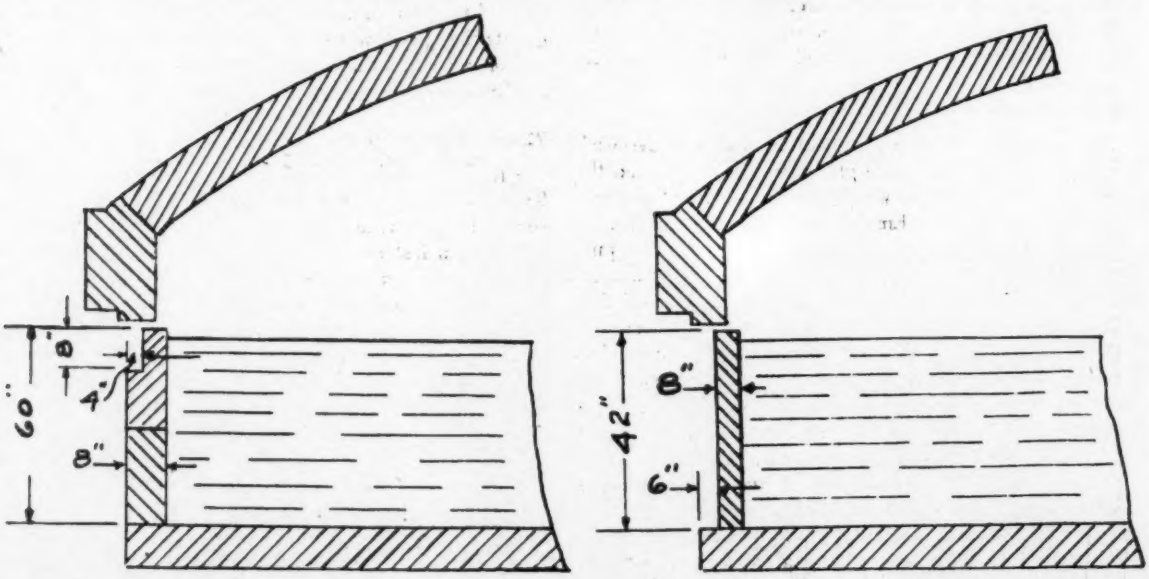
In many larger furnaces the tank blocks are set far enough into the furnace for the steel work supporting the breast wall to be entirely outside the block line. This method of construction exposes to the direct heat of the flame both the top and inside surface of the block, down to the glass line.

The method of retarding wear of the blocks along the glass level is to cool this area by currents of air directed against the outside surface of the wall. Large quantities of air are employed for this purpose at pressures as high as four to five inches of water. This system is particularly effective with the more dense type of refractories which have been developed in recent years and which have a much higher heat conductivity than the ordinary fire clay refractories. As air cooling is the most satisfactory method of retarding erosion of tank wall blocks, strenuous efforts are made to use it as completely as possible for thus purpose.

Fig. 1. Photograph of an old tank showing the degree to which water cooling was applied 10 years ago.

Under most conditions it is possible to do this, but in certain cases it is necessary to take further precautions to protect the furnace walls in the latter part of its campaign. This is done when the outside surface of the blocks show a red color depite the air blasts directed against them.

In early practice of tank operation it was customary to stop production at this time and ladle sufficient glass out of the furnace to lower the level below the first course of blocks. The fires were then reduced until a temperature sufficient to prevent the furnace crown from



Figs. II A and B, showing two designs of wall construction and the filler block space (left) at the glass level in a deep tank, and (right) at full depth in a shallow tank.

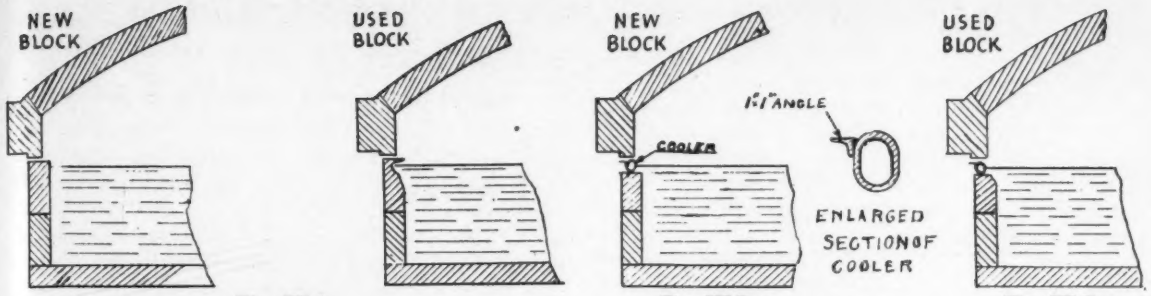


Fig. III A. Fig. III B. Fig. III C.

Showing how a cooler affects block erosion at the glass level. The upper course of wall blocks instead of being sharply undercut at the glass level (III A) was rounded off, as shown in III C.

contracting was reached; then the upper course of wall blocks was removed around the melting chamber and replaced with new. This was very trying work and also involved about 10 days loss of production.

For these reasons the "hot repair," as it was called, has been virtually supplanted by the use of water coolers, which are applied over hot spots as they appear on the tank walls. The first effect of applying a water cooler over a hot spot is to increase the temperature of the block under the cooler. This is due to poor contact between the cooler and the wall block, the cooler also acting as a screen to the air blasts which formerly impinged on the surface of the block. The block therefore melts away much faster under a water cooler than it did when exposed to the air. This goes on until the block gives away and allows the melted glass to come in contact with the cooler. When this occurs a layer of chilled glass forms over the surface of the cooler and a more stable condition is reached.

As the number of water coolers is increased the heat lost to the circulating water increases, until the capacity of the furnace to maintain the proper melting temperature is finally exceeded and it is necessary to shut the furnace down for a cold repair.

The accompanying photograph shows the degree to which water cooler application was carried out ten years ago on large glass furnaces using clay refractory blocks.

As mentioned before, the use of refractories of higher density has increased heat transmission through the blocks to a point where the cooling requirements can be met, as a rule, by air blasts. In cases of more severe service a few coolers are still used around the filling end of the furnace but seldom beyond the first port.

In many glass factories water coolers are not used on the furnace side walls, and other methods of supplementing the air cooling are employed. An old but rather unusual use of steam jets in addition to an air blast was recently observed on a medium sized tank furnace. The circumstances were particularly favorable to the use of steam in this case, as electric power was purchased and steam boilers were kept under pressure as a fire protection requirement.

In order to secure increased radiation from the tank blocks and make air cooling more effective, thinner blocks are sometimes used in the wall construction and, later on in the life of the furnace, are backed up with auxiliary blocks. Two designs which have been tried out in practical furnace operation are embodied in sketches II A and II B.

In the first method sketch No. II A, 8 in. blocks are used for the bottom course and a special block having a 4 in. section along the glass line for the top course. A 4 in. filler block is used to back up the thin section of the upper block when it becomes dangerously thin. In the one instance within the writer's experience in which this scheme was tried, Corhart blocks were used entirely. It was found that installation of the filler blocks was a hot and rather tedious job; also that they were no more efficient than the full thickness block in prolonging the life of the furnace. Then, because water coolers are used extensively in the factory in question, it was decided to place possibly a half dozen water coolers around the solid blocks at the filling end, as needed, in the expectation that these would be sufficient to carry the furnace through its normal campaign.

In the second method sketch No. II B blocks 8 in. in thickness and 42 in. in height form the entire side wall of the furnace. The furnace bottom is allowed to project six inches beyond the tank wall to provide a support for the filler blocks, which in this case are Laclede Christy "Fluxtite" blocks, four inches thick. Very good results have been secured with this scheme and the life of the furnace has been increased from 25 to 30 per cent by use of the filler blocks.

Another method of protecting the wall blocks at the glass level, which has recently been tried out in this country, makes use of a water cooler on top of the wall blocks. In this arrangement the height of the wall is reduced sufficiently to bring the glass level about half way upon the cooler as shown on sketch III B. The coolers consist of flattened sections of double extra heavy tubing, which are used in lengths of from three to eight feet depending on the obstructions in the path of their installation. They are sometimes sprayed with nickel before installation to make them less susceptible to corrosion and are fitted with pipe couplings, welded on at each end, for water connections.

No bad effects were observed from the use of these coolers and no difficulty or failure of the coolers was experienced during a year's operation of the furnace. The upper course of wall blocks instead of being sharply undercut at the glass level (sketch III A) as is usual, were rounded off on the upper corner as shown on sketch III C.

In using these coolers it was found best to delay their installation until the furnace walls had finished expanding. This was necessary to prevent the cooler becoming bound between the top of the blocks and the underside

of the furnace breast wall. The 1 in. x 1 in. angle welded to the coolers as shown in the enlarged section provides a support for the cement used for daubing. This type of wall cooler prevents the corrosive fluxes floating on the surface of the glass from coming in contact with the wall and allows the glass to flow over the top of the blocks screening them from the direct heat of the flame. This idea has also been used on some English furnaces where it has met with considerable success.

In general, it can be said that the problem of reducing erosion of furnace refractories at the glass line depends, to a large extent, on the conditions prevailing at each individual factory. If fuel costs are high a different approach must be made to the problem than would be done in cases when this factor is not so important. The tonnage and type of glass melted must also be considered.

U. S. CENSUS IN APRIL

In April, the Census Bureau will undertake to count the estimated 132,000,000 population of the United States. This 1940 census is the 150th anniversary of census taking in this country, which was begun in 1790 to provide a basis for apportioning membership in the House of Representatives. The new census forms ask 33 questions, but it is stated that the average person will be required to answer only half of these. On the other hand, a five per cent sample of the population will be handed "16 columns of questions."

Significant of the times, the question on illiteracy has been dropped as having dwindled to insignificant proportions. In place of this query, the question will be asked as to the highest grade of school completed. Other new questions are designed to measure internal migration, as movements from dust bowl areas; and to obtain a picture of the number of young people who have finished their schooling without being able to obtain work and acquire an occupation. Income questions are aimed to provide information on purchasing power.

THE KNOX GLASS ASSOCIATES BAND

Below is a picture of the Knox Glass Associates, Inc. Band, organized about two and a half years ago from employees and members of their immediate families. Already numbering 215 and on its way to a 300 maximum, this is believed to be the largest industrial band in the world. The band is organized into five separate groups, each group meeting once each week for training under the direction of Mr. I. N. Huffman. On special occasions, the five groups are consolidated and play together as one unit.

Uniforms were supplied by the member glass companies, which also donated the larger musical instruments, such as bass horns, bass drums, etc. Mr. Roy Underwood, president of Knox Glass Associates, has told THE GLASS INDUSTRY that the investment in the band already is considerable. But as Mr. Underwood is noted for the affection in which he holds his employees as well as for the respect and admiration which, high and low, they return to him, one may be quite sure that the cost would have been met just as readily had it been far higher, and also that the investment is paying real dividends.

W. B. LAWSON RESIGNS FROM HARSHAW

W. B. Lawson has resigned as vice-president of the Harshaw Chemical Company, Cleveland. Mr. Lawson joined the Harshaw organization in 1930. Previous to joining the Harshaw Chemical Company, Mr. Lawson was for years with The International Nickel Company, holding various executive positions and when he left the Nickel Company in 1930 he was Director of Sales, which position he had held for some years.

The 215-piece band of the Knox Glass Associates

A LIGHT-SENSITIVE GLASS AND ITS APPLICATION FOR ULTRA-VIOLET MEASUREMENTS

By LEE O. UPTON
THE PENNSYLVANIA STATE COLLEGE*

The study of the solarization of glasses, that is, the discoloration of glasses under the influence of sunlight has provided a fair understanding of the reactions underlying this phenomenon. Especially, experimentation with glasses* which were made sensitive to the action of light by the willful introduction of minor quantities of oxides other than those encountered in technical glasses helped to improve the knowledge of photochemical reactions in glass.

Solarization in glasses is a defect which has caused many troubles for the glass industry and it was from this point of view that the practical glassman has heretofore been interested in obtaining a greater knowledge of the process causing this defect.

For climatological purposes, medical purposes, testing of materials, and other purposes, it is often of interest to determine the action of ultra-violet light or to know by what amount of ultra-violet such actions are brought about. In other words, for many technical purposes it is necessary not only to be able to determine the momentary effect of ultra-violet radiation, as determined by the momentary intensity of the light source, but also to find the cumulative effect of such ultra-violet radiation for which purpose it is also necessary to have data on the integrated intensity over longer periods of time. It is self-evident that for artificial light sources the integral light intensity may often be computed from momentary measurements, since for such light sources, under ordinary conditions, constant radiation may be assumed. However, for investigation of the effects brought about by the ultra-violet part of sunlight, it will be necessary, at least, to measure the integral light intensity over the desired period of time. Therefore, whenever the action of the ultra-violet region of sunlight over a protracted period of time, is under consideration, all methods which are based on immediately reversible reactions cannot be used, or at least can be used only when they are combined with a continuous registration system. In this connection, Frankenburger's[1] dosimeter may be mentioned by way of example. This has found wide application, but is not adaptable, however, for direct measurements of integral ultra-violet intensities.

It appears obvious that for the measurement of ultra-violet radiation, it would be preferable to employ photochemical reactions which are irreversible and show a summation of the incident radiation over prolonged periods of time. Apparently, many of the solarization phenomena observed in glass comply with these requirements. For practical purposes it is desirable that the color change after short intervals of time may be detectable by the naked eye. However, complete discoloration should take place only over an extended period of time. This can only be the case if the wave length range sensitive to sunlight and the wave length range in which discoloration takes place are separated. This means that the color change brought about by solarization should not act as an internal filter for further solarization.

Most of the known solarizing glasses are therefore excluded because the reactions taking place are extremely slow, so, for example, the well-known purple discoloration of the manganese-containing glasses becomes visible only after long irradiation. Other changes such as in cerium-arsenic glasses which occur relatively rapidly lead to color shades which make comparison with the naked eye difficult, and thus would necessitate the determination of the cumulative change obtained by means of spectral measurements or optical density measurements.

However, one special photochemical reaction in glass appeared to be very promising for its application to ultra-violet measurements. H. Löffler (personal communication to W. A. Weyl) found that glasses containing cerium and vanadium, which were subjected to sunlight, change from a green to a pale purple color. Such glasses, when of the right composition, show appreciable color changes when exposed to bright sunlight for relatively short periods of time. As discussed in detail in a paper by A. E. Badger, A. G. Pincus, and W. A. Weyl,[2] it may be seen from comparison with aqueous solutions of vanadium salts that the green color may be attributed to the trivalent vanadium ion, while the pale purple color is attributable to the divalent vanadium ion. It is interesting to note that even under extremely reducing conditions the divalent vanadium cannot be obtained in a silicate glass and thus seems to be very unstable in glass under ordinary conditions. However, by means of photochemical reaction it is possible to arrest in a glass metastable states. Accordingly, the photochemical reaction occurring in such cerium-vanadium glasses may be given by the following reaction formula:

$$Ce_2O_3 + V_2O_3 = 2CeO_2 + 2VO$$

This reaction, similar to the other photochemical reactions in glass, is heat reversible with appreciable speed at about 300°C.

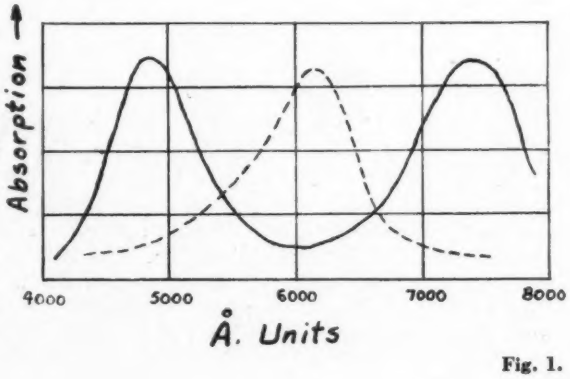


Fig. 1.

*Now with Bausch & Lomb Optical Co.

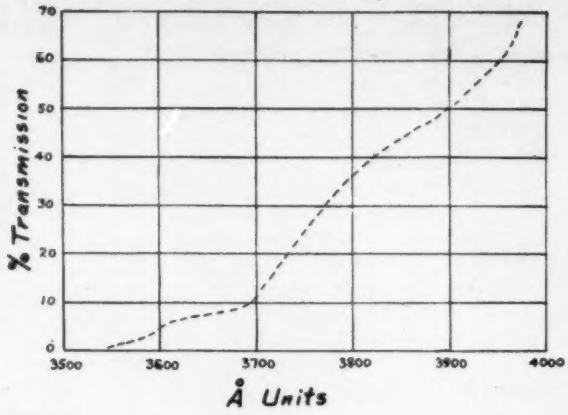


Fig. 2.

Properties of Cerium-Vanadium Glasses

The suitability of such a cerium-vanadium glass will be more readily understood when comparing the spectrum of such a glass in its normal green state with its spectrum after it has been changed by complete solarization to the purple state. In Figure 1, the absorption spectrum in the visible range (4,000-8,000Å) for a glass containing cerium and vanadium both in the normal and in the solarized state is given. This absorption spectrum is that of vanadium only, the cerium having in these glasses an appreciable color only in the ultra-violet. The curve in solid line corresponds to the absorption of the vanadium in the trivalent state. As can be seen from the absorption of the trivalent vanadium, the main ranges of absorption are in the blue and in the red, thus giving rise to a green color. An entirely different absorption curve is present after solarization, there being instead of two maxima only one in the green part of the spectrum, giving rise to the purplish color. In Figure 2, the transmission curve in the ultra-violet is given and it may be noted that the spectrum in this region does not change with solarization. This fact is of special importance for the use of such glasses for ultra-violet measurements because it is just this range which is sensitive for the photochemical reaction. As it is, the color change in these glasses is approximately proportional to the amount of incident light and the glass changes its color tint from greenish over yellow to pink and finally to purplish when seen through comparatively great thicknesses.

The above spectral measurements are taken from soda-lime glasses containing cerium and vanadium oxides. The soda-lime glasses throughout the investigations have been found to be most satisfactory for the purpose in mind. However, for scientific reasons, it appeared to be of interest to investigate the influence of other base glasses.

It has been found in previous work (see Badger, Pincus, and Weyl)[2], that the color of vanadium-containing glasses is dependent upon the composition of the glass. As has been pointed out in this paper, the glass surrounding a color center will solvate it to a different degree according to the nature of the surrounding glass. Due to these solvation forces, the spectrum of the color center will be shifted to longer or shorter wave lengths. Another effect on the color, which is more expressed with vanadium in glass, is the basicity or acidity of the base glass which favors the pentavalent vanadium ion or the trivalent vanadium ion, respectively. The more alkaline the glass is, therefore, the more vanadium will be present in the pentavalent state or, in other words, as the colorless vanadate. On the other hand, the more acid the glass is, the more vanadium will be present in the trivalent state. Also, the stronger the acid used, the brighter will be the color.

In pursuing these experiments, the influence of phosphoric acid and of boric acid was studied. It was found that the addition of phosphoric acid has a retarding action upon the photochemical reaction. Glasses rich in phosphoric acid have a very bright green color and do not solarize at all. The color of such glasses resembles the bright green color of vanadium in acid solutions. Glasses such as those containing up to about 10 per cent phosphoric acid also show the retarding effect of the phosphoric acid on the photochemical reaction. For example, with additions of about 2 per cent phosphoric acid to a sodium disilicate glass, after complete solarization, only a slightly purplish-pink of much less color depth than that obtained in a soda-lime glass of the same cerium-vanadium content was reached. With the addition of about 8 per cent phosphoric acid to a sodium disilicate glass, all the colors obtained on solarization had a greenish undertone. Comparison of these glasses with each other was made difficult by the fact that the phosphoric acid not only has an effect upon the sensitivity of the glasses, but also on the spectra, which may be attributed to the divalent and trivalent vanadium so that with each further addition of phosphoric acid not only the sensitivity is changed, but also the spectra.

Similar effects although much less pronounced were also brought about by additions of boric acid to sodium disilicate glasses.

Another factor which is of importance for the color changes obtained in such cerium-vanadium glasses and thus for their application for practical purposes is the ratio of cerium oxide to vanadium oxide. Here it is obvious that high cerium concentrations have to be excluded from consideration for practical use since the high absorption of ultra-violet at high concentrations would not allow sufficient penetration of the ultra-violet light into the interior of the glass and thus would prevent solarization throughout the glass. The upper limit of vanadium oxide is, of course, dependent upon the upper

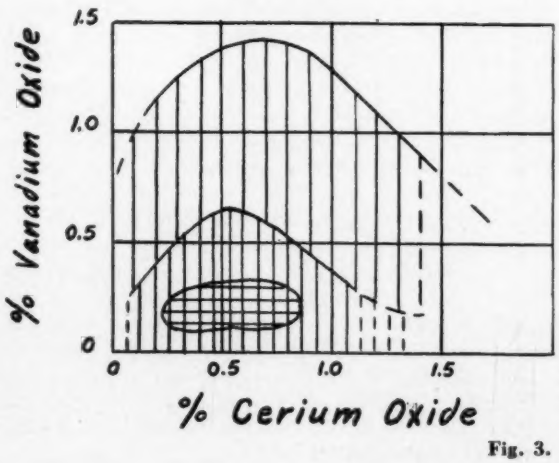


Fig. 3.

limit of the cerium oxide. As far as the lower limit of vanadium oxide is concerned, this is mainly determined by the color depth of the vanadium oxide. Since vanadium both in the divalent and trivalent states gives rise only to rather faint color, it always will be desirable to keep the vanadium oxide content as high as possible.

The results of investigations concerning the influence of the ratio of cerium oxide to vanadium oxide are summarized in Figure 3. For all these experiments, a glass of the following composition was used:

$SiO_2 = 72\%$
$CaO = 12\%$
$Na_2O = 16\%$

The variations of vanadium oxide and cerium oxide are shown by the coordinates of Figure 3. The innermost, cross-hatched area in the figure designates the field of glasses showing satisfactory color changes. The surrounding area includes ratios which only give rise to less and less noticeable color changes. Glasses falling within the outermost region shown displayed no color change at all when exposed to ultra-violet radiation.

The influence of slight increases of cerium oxide above the average ratio for most satisfactory glasses containing 0.5 per cent CeO_2 and 0.5 per cent V_2O_5 may be illustrated by the following experiments:

	Per cent	*Per cent*	*Per cent*
SiO_2	72	72	72
CaO	12	12	12
Na_2O	16	16	16
CeO_2*	0.5	1.5	2.0
V_2O_5*	0.5	0.5	0.5

*Additions of CeO_2 and V_2O_5 over 100 per cent batch

These glasses were drawn into rods of the prescribed thickness and length and were subjected to solar radiation for 8 hours. Every 2 hours one test piece was withdrawn. One additional piece was exposed to sunlight until apparently no further change in its color was obtained, or in other words, until it was completely saturated. Comparison of these series showed that by increasing the cerium oxide content the color of the unexposed glass takes on a more yellowish tint. On comparison of color changes after increased solarization, it became apparent that no exposure time with either one of the glasses containing 1.5 per cent or 2.0 per cent of cerium oxide produced colors matching any of the colors obtained with the glass containing 0.5 per cent cerium oxide. In the glass containing 0.5 per cent cerium oxide the color changed from the greenish vanadium color over faint yellow, orange-yellow, pink, light purple, to darker purple. All these colors are rather clear. In the glass containing 1.5 per cent cerium oxide, the color changed from faint yellow over to two faint brownish-yellow shades to brown and finally to a more reddish-brown. In the third series of glasses, containing 2.0 per cent cerium oxide, the color change was still less perceptible, the glasses from the unsolarized state to 8 hours exposure changing only to a deeper slightly brownish-yellow and on saturation reaching about the same color as the glass containing 1.5 per cent cerium oxide which had been exposed for 6 hours.

These results may be explained by the fact that by increasing the cerium oxide content the sensitivity of the glass is decreased and at the same time the color of the cerium itself covers up the color changes of the vanadium oxide. Of course, the comparison of such slightly different yellowish to brownish shades obtained with these glasses containing increased amounts of cerium oxide is difficult and excludes these glasses from practical application for ultra-violet measurements.

Application of Cerium-Vanadium Glasses for Ultra-Violet Measurements

When the first experiments for irradiation of cerium-vanadium glasses were planned, it was thought that glass plates would be suitable for ultra-violet measurements, and therefore, discs 50 millimeters in diameter and 3 millimeters thick were used. These plates were prepared by the Bausch and Lomb Optical Company. This method was chosen to provide the possibility of comparing the color changes due to irradiation with one of the commercial colorimeters. These discs were exposed to solar radiation on a white background in a horizontal position. Besides the fact that these plates were too thick to obtain complete solarization throughout the mass, the faint color of these test pieces did not permit a sharp distinction between the various color tints on successively increasing irradiation. Of course, spectroscopic analysis would have allowed exact evaluation of results thus obtained; however, then the main advantage of this method, that is, its simplicity, would have been lost. Moreover, cutting, grinding, and polishing of such discs would have made this method expensive for practical use.

Having in mind all these considerations, but especially the aim to have the glass in a form which would allow observation through great thicknesses of the mass on one hand, but still permitting only a small thickness to intercept the light path on the other hand, led to the development of a method for producing these glasses in rod or fiber form.

The length of fibers used was arbitrarily set at 50 millimeters. Therefore, the original fibers, after they were drawn from the melt, were calipered and cut in 50-millimeter lengths and their ends fire polished over the flame of a Bunsen burner. Since it was practically impossible by means of the method used to control the diameter of each long fiber to within the desirable limits, all those fibers which fell below or above the limits of 1.0 mm. were discarded. The fire polishing of the ends of each 50-millimeter fiber served a twofold purpose, the first being the elimination of the rough, broken ends of the glass, and the second and most important being the lens effect produced on each end, which was a considerable aid in the later determination of the color tint obtained when these fibers were solarized.

In order to determine the proper fiber diameter for ultra-violet measurements, fibers of different diameters were prepared and subjected to sunlight until apparently no further solarization took place. It was found that up to diameters of about 1.2 millimeters the glasses appeared to be rather uniformly discolored throughout their mass, while fibers having a larger diameter showed a distinct core formation.

The core formation may be explained by the fact that the cerium has from a certain thickness on absorbed all the incident, active ultra-violet light so that from this

depth on towards the center no ultra-violet light of the activating range is transmitted. Since the samples examined have been exposed for extremely long periods of time, it is understandable that down to the core section into which no active light finds its way, almost complete solarization is obtained. Obviously, on shorter exposure times the color graduation of the outer section would be more pronounced, since at any given time the intensity of active light in the outer sections would be larger than in the inner sections approaching the core. It may be assumed that the intensity of the incident light determines the probability of occurrence of the photochemical reaction rather than the energy necessary for this reaction. The energy for this reaction would be mainly determined by the frequency of the incident light. Therefore, if sufficient time elapses, complete solarization can also be obtained in those layers to which only little ultra-violet light is transmitted at any given time.

Fibers made from the glass containing 0.5 per cent cerium oxide and 0.5 per cent vanadium oxide and which were drawn to the proper diameter were found to be very satisfactory for practical application. They are easily handled and offer when observed endwise sufficient color depth for visual comparison of colors. Of course, in using these fibers, it is necessary that they be placed in comparable positions when subjected to the action of light; because, for the photochemical process, the angle of incidence of the light is of considerable importance.

Thus far, these glasses have been studied mainly for their usefulness in climatological observations.[3]

For these purposes, a comparison scale for actual measurements was prepared by subjecting individual fibers to the action of ultra-violet light for varying lengths of time so that each individual fiber was brought to a definite color tint corresponding to a definite amount of ultra-violet light, or in other words, to a definite amount of light energy. This color scale consisted tentatively of 10 different color tints comprising the color change from green to yellow, to orange-yellow, to pink, to light purple, to dark purple when viewed through the lengths of the fibers. In this scale, the green is the first step which corresponds to the unexposed glass having all the vanadium in the trivalent state, while the dark purple is the last step which corresponds to the completely solarized glass having all the vanadium in the divalent state. The intermediate steps correspond to intermediate ratios of trivalent and divalent vanadium. These color scales when not subjected to direct sunlight are practically stable over any period of time. For practical purposes, it was found to be of sufficient protection to imbed the fibers so that only the ends were exposed for observation.

For actual measurements of ultra-violet intensities, for example, in sunlight, fibers of the same dimensions as used in the comparison scale were prepared and subjected to the radiation to be measured. By way of example it may be mentioned that on a bright summer day noticeable color change can be detected in the short period of one hour and under the same conditions further changes are distinguishable from each other up to about 10 hours exposure.

The usefulness of this method has been shown by tests made by a large number of meteorological stations throughout the United States and also by a comparison of this method with numerous other approved methods.

It may be assumed that this method may be successfully used in many other fields where there is an interest in ultra-violet radiation over relatively long periods of time and where a simple and inexpensive method is desired. (Bleaching of colors, textiles, paints.)

As can be seen from the ultra-violet spectrum in Figure 2, the cerium oxide appears to have a maximum absorption at about 3500 Å, that is, just in the region of the most active ultra-violet radiation of the sun. This method therefore, will be most satisfactory wherever the ultra-violet radiation of the sun is of importance but also where artificial light sources are used or where processes are investigated which fall within the wave length range of about 3000 to 3300 Å units. A few of the possible applications of this method may be cited as follows: testing of materials, such as paints, textiles, foods; biological tests; and medical tests. In the near future, this method will be made available on a commercial scale and adapted to its various uses.

Summary

The usefulness of cerium-vanadium glasses for the measurement of ultra-violet light has been studied and discussed. The conclusion has been drawn that these glasses are especially suited for the measurement of ultra-violet light over protracted periods of time.

Phosphoric acid and boric acid were found to have a preventive effect on the photochemical reaction between cerium oxide and vanadium oxide while soda-lime glasses provide a satisfactory base glass for this reaction.

This method has been successfully tried out in climatological investigations. Various other applications of this method were suggested.

*This light-sensitive glass is being produced in fiber form by the Bausch & Lomb Optical Co. at Rochester, New York. A simple, standard color comparator is being developed, which along with the standard fibers, will be available for distribution in the near future.

[1]Frankenburger, W., Second International Congress of Light, Copenhagen, 1932.

[2]Badger, A. E., Pincus, A. G., and Weyl, W. A., J. Am. Cer. Soc. 1939.

[3]Landsberg, H. and Weyl, W., Bull. Amer. Meteor. Soc., Vol. 20 No. 6 (June 1939)

PITTSBURGH ART DIVISION MEETS

The Art Division and the Pittsburgh Section of the American Ceramic Society held its second joint meeting at the Mellon Institute, Pittsburgh, Tuesday, February 13. A full program was arranged with afternoon and evening sessions, a dinner meeting, and demonstrations.

The afternoon session was under the chairmanship of J. Palin Thorley, and Professor Walter Read Hovey, of the Fine Arts Division, University of Pittsburgh, opened the meeting with greetings from the University. Dr. Ross C. Purdy was the official starter and commentator for the evening session. Six papers were presented under the following titles: *Excavations at Tell Beit Mirsim*, by Dr. Kelso of the American School of Oriental Research; *Modern Grecian Glass*, by Dr. Alexander Silverman, University of Pittsburgh; *Creative Development in Dinnerware Industry*, by M. V. Broomhall, Edward M. Knoles China Co; *Porcelain Enamel Murals—Simplified*, by Daniel Boza, designer, Cleveland Art School; *Design Pays Dividends*, by Don Hadley, industrial designer, Westinghouse Electric and Manufacturing Co; *Ceramic Sculpture*, by Waylande Gregory, ceramic sculptor.

CURRENT STATISTICAL POSITION OF GLASS

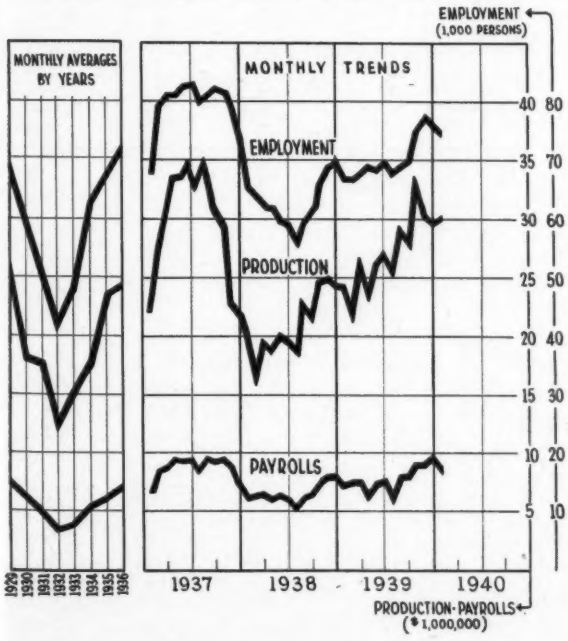
According to GLASS INDUSTRY's Production Index, January proved another extremely active month with total output estimated at over $30,000,000. Establishing a contra-seasonal trend this figure represented a slight increase over December's total and exceeded January of last year by about 25 per cent. Almost all branches of the industry contributed to this high volume; window and container plants were particularly active but plate and illuminating ware operations slowed down.

Plate Glass production during January totalled 17,257,241 square feet, according to the Plate Glass Manufacturers of America. This was a decline of 7 per cent from the preceding month but was 41 per cent greater than the same month of 1939. Activity during the month under review was at a higher level than in any January since 1936.

Window Glass output during January amounted to 1,413,432 boxes, according to the Window Glass Manufacturers Association. This represented an increase of 19 per cent over the previous month and, with the exception of June 1937, was the largest monthly total on record. (Monthly statistics for this industry were first published in January 1937. While the period of peak production for the window glass industry was reached during the building boom era of the middle 1920's, monthly figures of the output of that period are not available.) January recorded a net gain of 50 per cent over the same month a year ago.

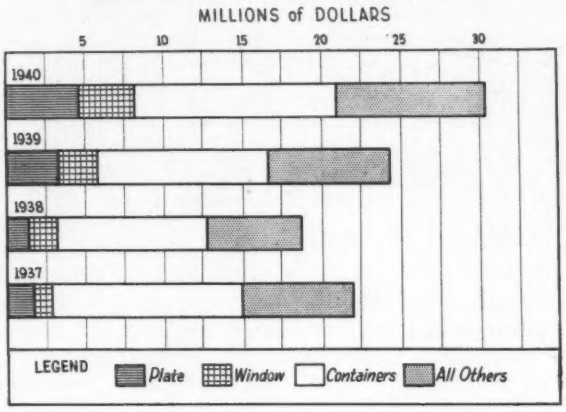
GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through January, 1940



GI THE GLASS INDUSTRY'S INDEX

Production for the month of January



Glass Container production during January was reported at 4,263,007 gross, according to the Glass Container Association. This exceeded December's activity by 5 per cent and January 1939 by 19 per cent. Manufacturing activity in this industry was at a higher rate than in any previous January on record. Shipments during the month under review increased 20 per cent above the previous month's level, but failed to relieve the current high inventory position. As a matter of fact, by the end of January stocks on hand had soared to an all-time peak—9,600,550 gross.

Miscellaneous Glass Products manufactured during January were valued at almost $9,300,000, according to reliable estimates. This almost equalled the output of the previous month and exceeded January 1939 by over 20 per cent. Illuminating ware activity continued its seasonal decline, dropping between 10 and 15 per cent below December; however, it was about 5 per cent above the 1939 level. Production of other items, such as tableware, scientific, technical and industrial ware, was unusually high for this period of the year.

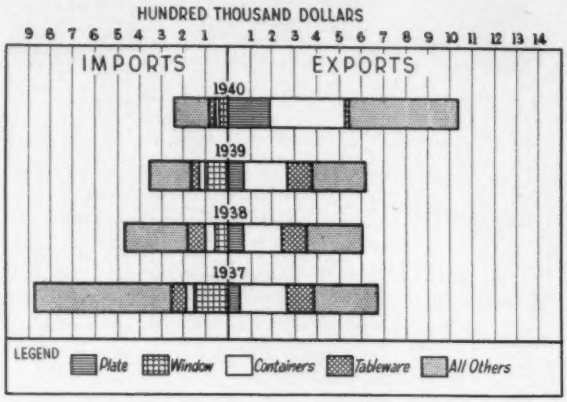
Employment and Payrolls. At least 74,100 persons were employed in the glass industry during January, according to preliminary figures announced by the Bureau of Labor Statistics. This preliminary estimate is believed to be ultra conservative, and the actual number of wage earners is expected to be somewhat higher when the Bureau issues its revised totals. It compares with almost 76,000 in December, and with 66,500 in January a year ago.

Payrolls in the glass industry during January were valued at about $8,400,000 according to preliminary estimates. This was some $300,000 below the December figures but will probably be increased as revisions are made in these statistics. January 1939 payrolls totaled $7,000,000.

(*Please turn the page*)

THE GLASS INDUSTRY'S INDEX

Foreign Trade for the Month of January



Foreign Trade: United States foreign trade in glass during January was valued at $1,270,000, a decline of 8 per cent from the previous month but 31 per cent ahead of January, 1939.

Exports of glass products during January were valued at $1,035,000. This figure shows a slight dip below the previous month but registers a 69 per cent increase over January 1939. Largest volume increases were noted in glass containers and plate glass while window glass shipments recorded an increase of 200 per cent. Declines from December levels were noted in practically all lines with the exception of plate glass which was up 92 per cent. On a value basis greatest decreases were reported for tableware items while on a percentage basis window glass dropped sharply.

Imports of glass products during January were valued at $235,000. This represents a decline of 23 per cent from December and 34 per cent from January of last year. Plate and window glass imports increased sharply over January of 1939 but all other items showed decreased purchases from abroad. Illuminating ware figures were 89 per cent below January of last year and 71 per cent less than last December.

DR. J. T. LITTLETON WINS PROMOTION

Dr. J. T. Littleton, physicist of the Corning Glass Works, has just been promoted to the newly created position of assistant director of research. Dr. Littleton has been connected with the company for the past 27 years and since 1920 has been chief of the Physical Laboratory.

Dr. Littleton is prominent in the affairs of the American Ceramic Society, of which he is a Fellow. From 1929 to 1931 he was chairman of the Glass Division and in 1932, Chairman of the Publications Committee. He was named a trustee of the Society, 1935-1938. He has prepared numerous papers and monographs on phases of glass technology and his conclusions are regarded as definitive in their field. Numerous patents have sprung from his research. In 1933, with Dr. G. W. Morey, he was author of a book, "The Electrical Properties of Glass."

Dr. Littleton has won a host of friends in the glass industry by whom his promotion will be received as most welcome news.

FOREIGN TRADE OPPORTUNITIES

Below is a list of recent inquiries received at the Specialties Division, Bureau of Foreign and Domestic Commerce. Those interested should write immediately to H. B. McCoy, chief of the Division, specifying the reference numbers of any inquiries they wish to contact.

Reference Number	*Commodity*	*City and Country*	*Purchase or Agency*
6250	Glass containers, hospital and laboratory	Cairo	Both
6218	Glass lamps and crimped toy chimneys	Bridgetown, Barbados	Both
6225	Glassware and porcelain	Habana	Agency
6258	Glassware and porcelain, decorative and table	Toronto	Purchase
6300	Glassware, laboratory	London, Canada	Agency
6305	Glassware, chinaware, and earthenware	Cairo	Both
6314	Glassware and chinaware	Cairo	Agency
6412	Glassware and chinaware for soda fountains, restaurants and hotels	Toronto	Purchase
6475	Bottles for drugs and perfumery	Cairo	Agency
6477	Bottles, flasks, jars, and pots, and tin or plastic lids and caps	Capetown	Agency
6431	Glassware (cut glass), and pottery	Capetown	Agency
6206	Glassware, colored and crystalware	Melbourne	Both

UNITED STATES FOREIGN TRADE IN GLASS
(Values in Thousands of Dollars)

	1940	1939		Percentage Change	
	January	January	December	January-January	December '39 January '40
		EXPORTS			
Plate	196	72	102	+172	+ 92
Window	12	4	20	+200	— 40
Containers	337	199	350	+ 70	— 4
Tableware	126	104	204	+ 21	— 38
Illuminating Ware	50	37	59	+ 35	— 15
All Other	314	198	327	+ 59	— 4
Total	1035	614	1062	+ 69	— 5
		IMPORTS			
Plate	23	4	5	+475	+360
Window	37	100	27	+270	+ 37
Containers	15	22	14	— 32	+ 8
Tableware	47	34	61	+ 38	— 23
Illuminating Ware	4	38	14	— 89	— 71
Other	109	161	186	— 32	— 41
Total	235	355	307	— 34	— 23

ALKALI-FREE GLASSES

By DR. OSCAR KNAPP

UJPEST, HUNGARY

The handbooks and monographs dealing with glass technology characterize glass as alkali-earth, alkali-silicates, borates, or phosphates. This definition was put down a century ago by Dumas, who made up a normal formula for usable glasses. This glass formula was changed with the passing of time, though it remained unaltered with respect to qualitative views. Thus, it is connected with the idea of glass, that it contains alkali.

Glass experts later divided the oxides forming glasses into three groups. The first group contains the acidic oxides—silica, alumina, boric and phosphoric acids—which alone cannot be converted into a glassy state at the melting temperatures of the common technical glasses, or which are soluble in water and therefore chemically not durable. To the second group belong the oxides which form with the acidic oxides easily melting salts, which are also soluble in water or in acidic liquids. These oxides are called fluxing oxides. The third group, the group of the stabilizing oxides, comprises the oxides melted with alkalis and acidic oxides which, insoluble in water and acids, form glasses. The fluxing oxides are in every case alkali oxides. Thus, according to this definition also, glasses must contain alkali oxides—sodium or potassium oxide or both of them—as essential components.

With the rapid development of glass science during the last decades, the properties and effects of the different glass oxides were also thoroughly studied. Thus, it became known that the fluxing oxides lessen the melting point and electrical resistance and heighten the expansivity; and thus, they give properties which are not always desirable, sometimes even to be avoided. Modern technical development required special glasses, which could only fulfill the wanted functions if their alkali content was diminished continuously. However, the melting of glasses having a low content of alkali is very difficult. We must apply, with diminution of alkalis, higher melting temperatures. At the same time, the troubles connected with refining, working, and refractories become ever greater and more difficult to overcome. The modern glass industry could, however, defeat these obstacles step by step and make glasses which are not only poor in alkali, but which contain no alkali at all.

The number of alkali-free glasses grew gradually in consequence of the ever higher requirements demanded for technical glasses, and we know a considerable number of those. They make a separate group in modern glass science and industry.

The development which the alkali-free glasses achieved in the last decades should be put chiefly to the credit of the illuminating glass industry, which uses in some incandescent lamps glowing metal vapors instead of glowing metal filaments for generating light. The common silica glasses are attacked by the glowing metal vapors and blackness appears on the inner wall of bulbs or tubes, which causes increasing loss with the age of the lamps. The metal vapors attack the silica and reduce it to silicon monoxide, sometimes even to silicon metal. Therefore, the content of silica was lessened and such reducible oxides as lead and ferric oxides were carefully avoided. The illuminating industry also developed another kind of alkali-free glass. Some high-grade incandescent lamps became during use so hot, that the common and even the hard glasses would soften and deform. These lamps must have bulbs made of quartz glass. In these cases, we cannot use electrodes with the same low expansion as that of the quartz, because no such metal is known. We use, therefore, electrodes of metal with greater expansivity, and we use connecting glasses for binding the metal and quartz glass. These connecting glasses, which have expansion coefficients between the values of the metal and the quartz glass, are generally alkali-free.

The raw materials of the alkali-free glasses are in general the same as those of common glasses, but they cannot contain alkalis as impurities. This requirement makes the composition of an easily melting, good, refinable batch difficult, partly because the absence of alkali elevates the melting temperature, and secondly, because the refining agents all contain alkalis. In some cases, the alkali-free glass allows the presence of a small amount of alkali; but some glasses, especially those for electrotechnics, are wholly unusable if small amounts of alkali are present. We have to take into consideration the greatest possible purity, especially the absence of ferric compounds, in the selection of raw materials.

The refractories which are used in furnaces for melting alkali-free glasses must be of high fire-resisting quality. We use, for the high-melting glasses, tanks because the best pots fail at temperatures in excess of about 1500°C. There are used as refractories very dense or fused ceramic products; e.g. sillimanite, Corhart, etc. The construction and working of the furnaces, in which alkali-free glasses are to be melted, require great experience.

The more silica the alkali-free glasses contain, the higher is their melting temperature. Boron, phosphorus, and lead oxides have a lowering effect. The alkali-earths and magnesia are rather ineffective. Beside the lead glasses, the alkali-free glasses are very hard, stiffen very quickly, and the working temperatures are higher than for common glasses.

In the chemical view, we can divide the alkali-free glasses into different groups according to their principal acidic oxide. Thus, we know silicates, borates, phosphates, and plumbates.

We give, in Table I, the compositions of some commercial glasses, and in Table I_a, the data as to source, purpose, and properties of these glasses.

The alkali-free glasses are not now rare products of the glass industry, and are used in ever-growing quantity

TABLE I

Glass No.	SiO_2	B_2O_3	Al_2O_3	CaO	MgO	BaO	ZnO	BaO	PbO	ThO_2	ZrO_2
1	25.0	15.0	30.0	30.0	...	.....	...	....	...	...	...
2	35.0	10.0	30.0	15.0	...	10.0	...	...	...	...	...
3	45.4	12.3	19.8	13.1	2.9	4.2	0.8	...	...	...	...
4	49.8	6.3	22.9	13.0	...	...	7.5	...	...	...	...
5	51.1	4.1	23.2	11.6	...	...	4.7	...	...	...	...
6	52.5	13.9	23.2	8.3	4.2	...	8.2	...	...	...	...
7	55.0	...	15.0	...	15.0	...	...	...	15.0	...	...
8	55.0	...	15.0	30.0	...	...	...	...	...	...	...
9	57.0	...	23.0	20.0	...	...	...	...	...	...	...
10	60.0	...	20.0	...	20.0	...	...	...	...	...	...
11	77.2	7.0	10.7	5.4	...	...	...	...	...	...	...
12	78.0	...	12.0	10.0	...	...	...	...	...	...	...
13	85.0	5.0	4.5	1.0	...	1.0	...	0.5	...	1.0	2.0
14	90.0	...	4.5	1.0	...	1.0	...	0.5	...	1.0	2.0
15	94.5	...	5.5	...	...	...	...	...	...	...	...
16	95.4	...	...	...	...	...	...	1.0	...	2.0	1.6
17	32.9	6.0	2.5	...	...	42.3	9.2	...	...	...	...
18	34.2	10.2	5.0	...	...	42.1	7.8	...	...	...	...
19	39.6	6.0	5.0	...	...	42.1	9.2	...	...	...	...
20	44.0	14.0	6.0	14.0	...	22.0	...	...	...	...	...
21	46.9	14.0	6.0	...	...	33.0	...	...	...	...	...
22	49.6	6.0	2.5	...	...	42.1	...	...	...	...	...
23	76.0	...	20.0	4.0	...	...	...	...	...	...	...
24	84.2	8.9	5.0	...	2.0	...	...	...	...	...	...
25	88.3	8.4	2.9	0.5	...	...	...	...	...	...	...
26	96.0	...	4.0	...	...	...	...	...	...	...	...
27	50.2	11.5	21.7	8.5	...	...	8.3	...	...	...	...
28	88.0	...	8.0	4.0	...	...	...	...	...	...	...
29	52.2	13.9	4.5	...	...	24.5	5.0	...	...	...	...
30	14.3	...	...	71.4	...	...	14.3	...	...	...	...
31	64.0	...	20.0	16.0	...	...	...	...	...	...	...

TABLE Ia

	Inventor	Patent	Use	Coeff. of Exp. x 10^7	Softening Temp. °C.
1	Patent Treuh.	DRP149303	Electrical Discharge Tubes	....	....
2	"		vs. Caesium vapor	....	....
3	Partridge[1]		Elec.	49	760
4	G.E. Co.	Eng. 476400	Discharge	....	....
5	Partridge		Tubes	....	....
6	"		"	43	930
7	Corning	Amer. 2148621	"	....	....
8	.....	E.P. 461111	vs. Caimium vapor	....	....
9	.....	"	vs. Magnesium vapor	....	....
10	Kraft	A.P. 2087762	E.D.T.	....	....
11	Int. G.E.	A.P. 2152988	"	....	....
12	.....	E.P. 461111	vs. Cd. vapor	....	....
13	P. Treuh.	Aust. 76706	E.D.T.	33	1000
14	"	.....	"	46	1000
15	Int. G.E.	A.P. 2152994	"	....	....
16	"	Ind. 25857	"	....	....
17	Jena	Melt O-2236	Optical	....	....
18	"	" vs-1442	"	....	....
19	"	" O-3192	"	....	....
20	"	" VS-3389	"	....	....
21	"	" 477111	"	....	....
22	"	" VS-1933	"	....	....
23	to 26	.....	Connecting glasses	20	....
27	G.E. Co.	.....	Electrical Reistance	....	....
28	.....	E.P. 467362	Heat Resistance	....	Very high
29	Jena	First one made	Combustion Tube	46	Spec. Grav. 2.848
30	.....	E.P. 496508	Infra-red Trans.	(No B_2O_3,P_2O_5,Fe_2O_3, or Co,Cu,Ni.)	
31	.....	E.P. 493803	Hard Glass	(Melted from Anorthite, $2SiO_2.CaO.Al_2O_3$)	

The borate glasses summarized in Table II are used for discharge tubes and for optical purposes. Other data on these glasses appear in Table IIa.

TABLE II

Glass No.	B_2O_3	SiO_2	Al_2O_3	CaO	BaO	MgO	ZnO	PbO
1	28.0	20.0	30.0	22.0	...	...	...	...
2	36.0	...	27.0	...	27.0	10.0	...	...
3	50.0	...	10.0	10.0	30.0	...	...	...
4	50.0	25.0	15.0	10.0	...	...	...	...
5	41.0	...	...	...	...	...	59.0	...
6	55.0	...	12.0	...	...	...	12.0	18.0
7	56.0	...	12.0	...	...	...	...	32.0

TABLE IIa

No.	Inventor	Patent	Properties and Use
1	.....	E.P. 465077	Res. vs. Sodium vapor
2	.....	D.R.P. 574755	Silica-free
3	.....	"	"
4	Partridge[1]	.....	Tubes for Na-vapor-discharge lamps
5	Jena	VS-665	Optical Borate Glasses
6	"	VS-6456	" " "
7	"	VS-428	" " "

[1] Similarly, Table III and Table IIIa describe alkali-free phosphate glasses.

TABLE III

No.	P_2O_5	SiO_2	B_2O_3	Al_2O_3	CaO	ZnO	BaO	As_2O_3
1	5.0	50.0	6.0	24.0	7.0	8.0	...	...
2	18.6	...	0	40.7	...	40.7	...	...
3	45.0	...	3.0	2.0	...	...	50.0	...
4	54.0	...	3.0	1.5	...	...	40.0	1.5
5	56.0	...	3.0	1.5	...	...	38.0	1.5
6	59.5	...	3.0	8.0	...	...	28.0	1.5
7	68.2	...	5.0	...	26.8	...	...	...

TABLE IIIa

No.	Inventor	Desc.	Properties and Uses
1	Chrinside	.....	Metal-vapor-discharge tubes
2	"	.....	" " " "
3	Jena	S-15	Heavy Dense Crown Optical Glass
4	"	S-30	" " " " "
5	"	S-95	" " " " "
6	"	S-40	" " " " "
7	Corning	A.P. 1830903	"Corex" for Ultra-Violet Transmission

– Some plumbate glasses appear in Tables IV and IVa.

TABLE IV

No.	PbO	SiO_2	B_2O_3
1	76.0	12.0	12.0
2	79.0	21.0	....
3	80.0	20.0	....

TABLE IVa

No.	Inventor	Desc.	Properties and Uses
1	Gallup	Connecting Glass	$9 = 92 \times 10^{-7}$ Soft. Temp. 500°C.
2	Jena	Melt S-227	Extra Dense Optical Flint Glass
3	"	" S-208	" " " " "

in their several fields of application. They have not only practical importance, but a theoretical one as well. Their invention has led, for example, to the discovery of some glass fields which were previously entirely unknown.

ANOTHER CONFERENCE ON GLASS PROBLEMS

A Glass Conference, the sixth in the series which have been given from time to time under the joint auspices of the Department of Ceramic Engineering at the University of Illinois and the Chicago Section of the American Ceramic Society, will be held at Urbana, Illinois, on Friday and Saturday, May 10 and 11.

A program of especial interest to plant operators and glass technologists is being prepared. Principal topics for discussion will be: The automatic control of pressure and combustion in furnace operations; Results of investigation of molds for glass forming; New developments in briquetting glass batch; A round table discussion of the most effective manner of stimulating useful suggestions by employees regarding plant operation—this last is by request.

EXPORT MARKETS FOR OPTICAL WARE

Acting in response to numerous inquiries as to the prospect for United States optical goods in foreign markets, the Specialties Division of the Bureau of Foreign and Romestic Commerce has prepared a bulletin on the subject, particularly relating to Latin America, Australia and New Zealand. This shows imports to these markets by quantity, value and countries of origin. Included are very complete statistical data on exports of optical goods from Germany and Japan, as well as a discussion of the markets of Southeastern Europe. A copy of this bulletin may be had on request addressed to H. B. McCoy, Chief of the Specialties Division.

INVENTIONS AND INVENTORS

Summary of United States Patents of Interest to the Glass Industry Issued During January

Furnaces

Paul G. Willetts assigned to Hartford-Empire Co. patent 2,186,223, covering a means of forming an insulated melting furnace bottom. It is illustrated by the accompanying figure, wherein the upper layer 13 is a dense flux block, bedded in a layer of granular refractory insulation 12, which rests on insulating brick 11. A particular feature is the use of a slip cast joint-filling material 16, which is poured repeatedly into the joints after the blocks are placed, the pouring being continued until the cracks are filled. A suitable slip composition for this purpose, described in the patent, consists of a dense sized alumina grain with additions of 4 per cent kaolin, 5 per cent ball clay, and enough silicate of soda and sodium carbonate to disperse the clay, so that a low percentage of water will bestow fluidity.

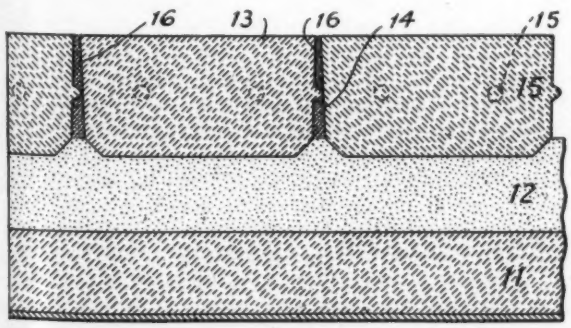
Feeding, Forming and Shaping

John Ferguson of Cleveland patented (2,186,718) a feeder arrangement for application to electric melting furnaces, wherein the glass itself acts as the resistance element in which the heat is generated for melting the batch. The invention is concerned with the provision of an electricity-conducting orofice unit and means for passing a current from this unit through the glass to an electrode in the melting chamber. By such means it is said to be possible to maintain the temperature on the surface of the extruding stream of glass substantially the same as that on the inside of the stream.

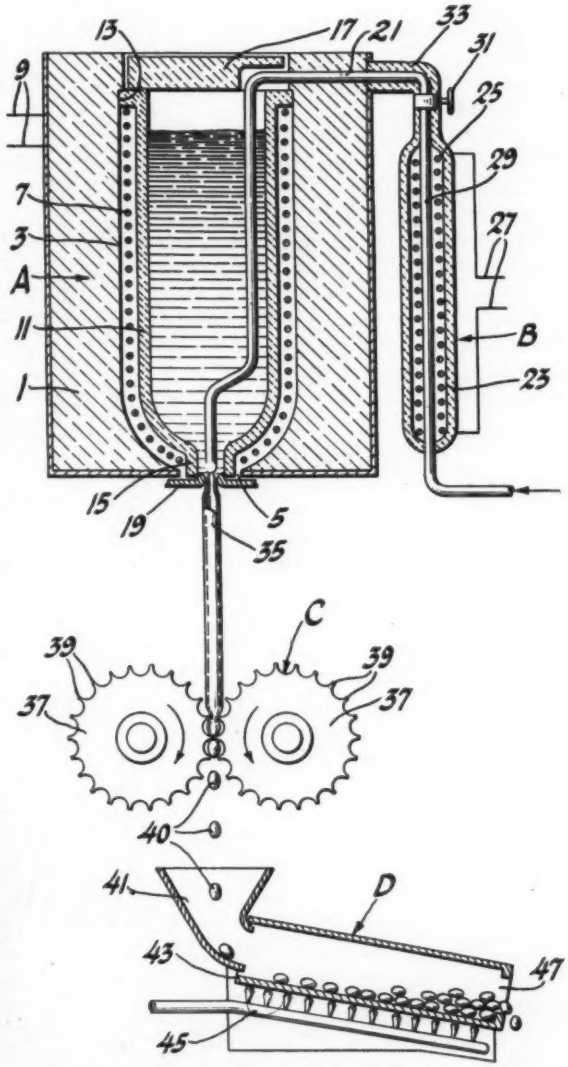
Thomas F. Pearson of Pontefract, England, whose many U. S. patents are assigned to Crown Cork & Seal Co., was granted two more patents in January. Patent 2,185,565 is directed toward overcoming blemishes produced by the shears on gathers for a machine for forming bottles or other ware. It provides an apparatus associated with the shearing arrangement for reheating and reshaping the gather to remove shear marks, before it is picked up for moulding. Pearson's other patent 2,186,174 concerns improvement in means for applying vacuum or pressure to the neck moulds, parisons and blow moulds of machines for forming bottles, jars, etc.

Earl R. Odom of Marion, Indiana, patented (2,185,678) a moulding mechanism said to be suited to glass, plastics and other plastic materials. In this machine gobs of glass are deposited in a hopper, allowed to pass through a valve and then to the mould, means being provided for closing the valve and allowing air under pressure to flow into the top of the mould to force the plastic charge into the mould.

Milton A. Powers of Detroit, Michigan, patented apparatus and method for making tiny vacuum cells suitable for use as thermal insulating material (2,187,432). The accompanying illustration shows a glass heating chamber A (top left), a vapor preheating chamber at B, cutters C, which cut a plastic glass tube into short lengths, and at the same time seal them to form small



2,186,223, Willetts, Hartford-Empire Co.: Insulated furnace bottom.



2,187,432, Powers: Apparatus for making tiny vacuum pellets for use as thermal insulation.

cells, and an annealing oven D. When the glass has become molten enough to flow through the orifice, superheated steam under low pressure is vented just above the orifice. This results in the flow of a tube of glass which would otherwise be solid. After the glass cells or bubbles are annealed, their cooling condenses the enclosed steam to produce a high degree of vacuum.

Rowland D. Smith assigned to Corning Glass Works, his patent 2,188,121 for a new method of drawing fused quartz tubing. Previous methods of making such tubing have been discontinuous, since they were necessarily based on the use of reheated billets or stock. The inherent difficulty of working fused quartz is due to its lack of a real working range; it requires a high temperature for melting, but remains pasty even at 2200 deg. F. The novelty of Smith's invention is indicated by the schematic drawing reproduced herewith. Chucks 25 and 26 on a turning shaft carry two cylindrical "baits" made of silica or other refractory to which fused silica will adhere. These baits are first butted together and finely divided silica is then deposited on them by an impinging oxyhydrogen torch. This deposit or ridge 45 is kept hot enough to remain viscuous. While it is being deposited the baits are rotated and drawn apart slowly at a rate which draws the plastic ridge continuously out into a cylindrical rod shape.

Theodore H. Sloan of Charleroi assigned to G. M. S. Corporation of Pittsburgh, his patent 2,186,179 for a tumbler press. Its nature is indicated by the first claim which describes the process as "charging a mould shaped to the outer contour of the finished article with a supply of molten glass, forming the charge by a plunger shaped to the inner dimensions of the finished article by subjecting the plunger to positive pressure of sufficient force to form the ware, and controlling the plunger travel independently of the degree of pressure to subject it to a controlled downward movement."

Patent 2,187,094 assigned by Johannes Pink to Patent-Treuhand-Gesellschaft für Elektrische Gluhlampen m.b. H., Berlin, is an apparatus for spinning and winding glass filaments.

Miscellaneous Processes

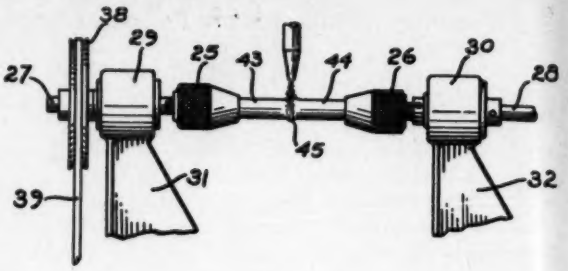
Another Corning Glass Works patent granted in January was 2,188,608 to J. T. Littleton and W. W. Shaver. In a circular kiln for tempering glass articles, they have found that the bottoms of the ware will be unmarked if the floor is covered with a soft water soluble refractory salt, such as magnesium sulphate or the sulphates of sodium or potassium. Alumina, talc, etc. have sometimes been used to prevent glass from sticking to refractory surfaces, but these particles may adhere or abrade the glass and, being insoluble, could not be removed by washing.

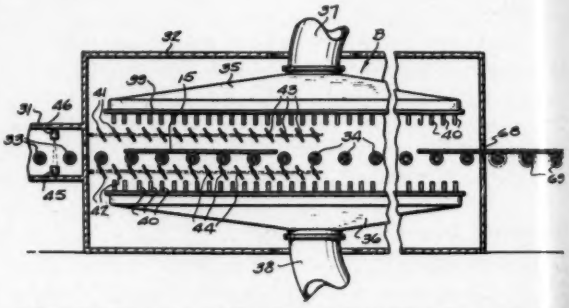
Patent 2,187,748 was granted to Anthony Macellaro and Anthony Tornese for a glass-bevelling machine.

To Charles F. Schmidt (Owens-Illinois) was issued patent 2,185,271 for assembling glass applicator rods to bottle caps.

Patent 2,185,704 granted to John F. Donovan and Frank J. Malloy, Cleveland, Ohio (assigned to General Electric) applies to a sealing-in machine for light-bulb manufacture.

2,188,121, Smith, Corning Glass Works: Method and apparatus for drawing fused quartz.



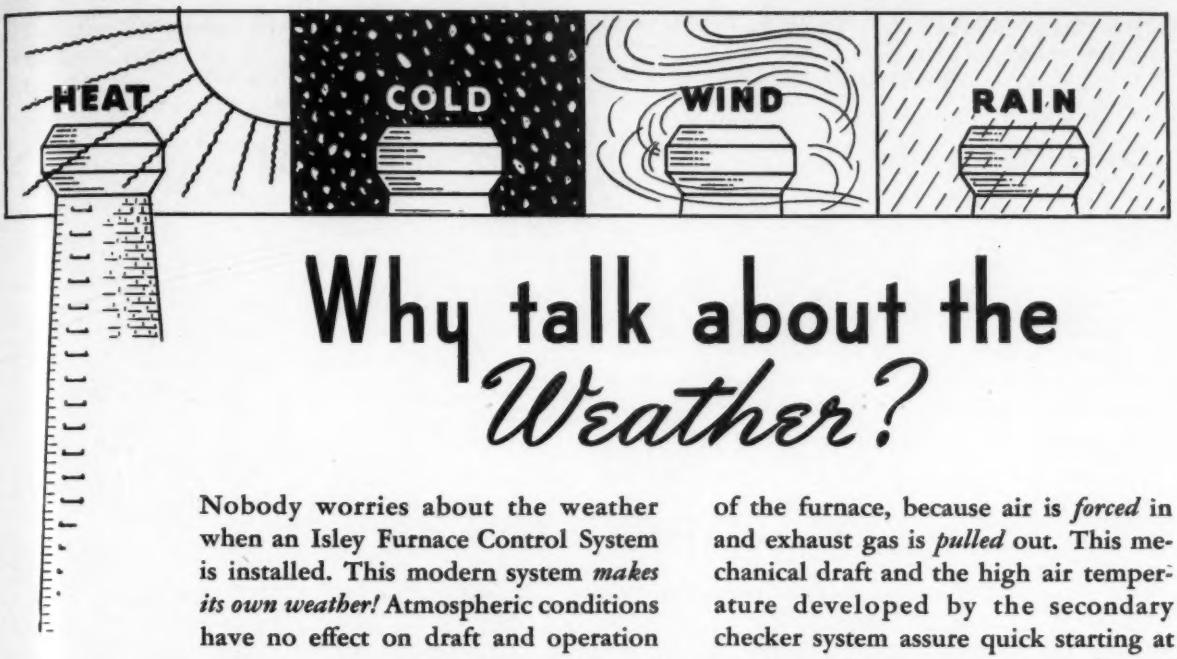


2,188,401, Crowley, Libby-Owens-Ford Glass Co.: Cooling zone of sheet-tempering apparatus fitted with shutters to deflect cooling air until sheet is entirly within the cooling space.

Plates and Sheets

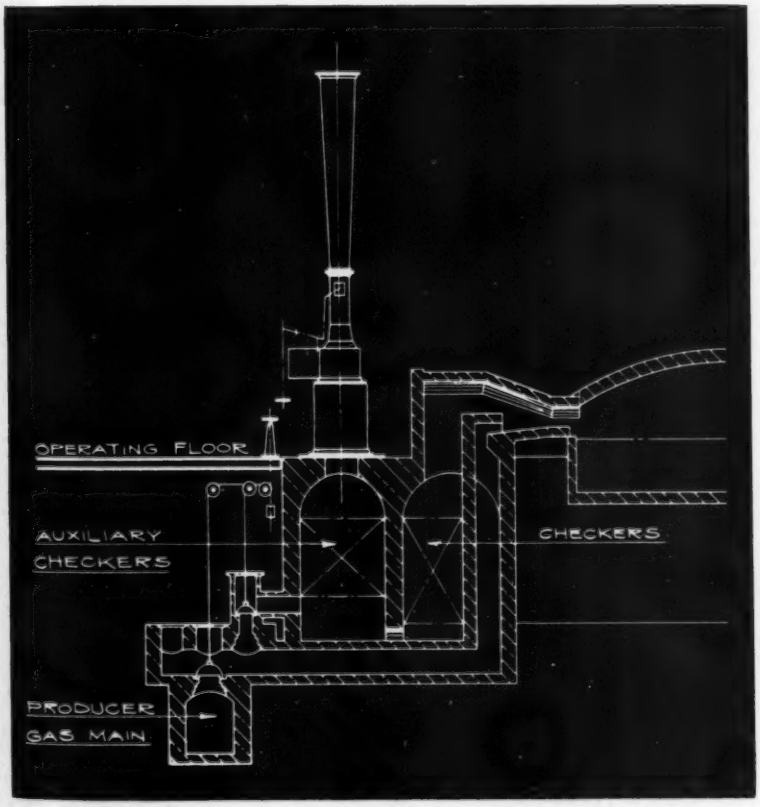
In their patent 2,188,395, assigned to Libbey-Owens-Ford, Joseph D. Ryan and George B. Watkins describe the step-by-step progress in adapting cellulose-aceto-butyrate plastics to laminated safety glass. It is stated that all attempts to bond such a layer to glass surfaces using ordinary adhesives have failed to produce adhesion. Their patent covers a chemical treatment which is said to completely change the adhesive characteristics of the plastic. The cellulose aceto butyrate, partially hydrolyzed, is heated for two hours at 200 deg. F in a 5 per cent sodium hydroxide solution. When this mixture is filtered, washed, and dried, a product is obtained which forms, with suitable solvents, an adhesive which will bond an untreated layer of the same plastic to glass sheets.

Patent 2,188,401 to Thomas R. Crowley (Libby-Owens-Ford) covers a sheet tempering apparatus with emphasis on the air-quenching features. The sheets are handled throughout on rollers which keep them in a horizontal position, thus eliminating the tong marks which may appear when the sheets are suspended vertically. When the sheets enter the air-cooling chamber an apparatus, operated by a photoelectric cell, prevents the blower from acting on the front end of the sheet until the entire sheet is in position for cooling. This feature is illustrated by the accompanying figure. The blowers 37 and 38 operate all the time. However, when a sheet moving from left to right enters the cooling chamber, it intercepts a light beam at 46, photo-electrically actuating an apparatus which deflects the blast by closing the shutters 41 and 42 until the sheet is entirely within. This overcomes uneven tempering.



Why talk about the *Weather?*

Nobody worries about the weather when an Isley Furnace Control System is installed. This modern system *makes its own weather!* Atmospheric conditions have no effect on draft and operation of the furnace, because air is *forced* in and exhaust gas is *pulled* out. This mechanical draft and the high air temperature developed by the secondary checker system assure quick starting at maximum capacity, regardless of furnace temperature. Flow of air under pressure also offsets clogging of the regenerative brick work by excessive slagging and helps to maintain high production.



Under the Isley Furnace Control System, each port of the glass furnace has its own checker chamber and individual stack, affording zone temperature control. Furnace conditions for any operating capacities can be accurately indicated and easily duplicated whenever desired. Savings in time, fuel and production costs are available to every glass furnace operator.

Let us send you complete information. Write for the Isley Bulletin.

V-20

MORGAN CONSTRUCTION COMPANY, WORCESTER, MASS.

English Representative: **International Construction Company, 56 Kingsway, W. C. 2, London, Eng.**

MORGAN WORCESTER ENGINEERS AND MANUFACTURERS

ISLEY *Furnace Control System*

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	45.00	51.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027 -.0295
Powdered	In bags, lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054 - .0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07⅛
Cryolite ($Na_3Al F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	30.00-31.00	....
In bags	ton	31.60-32.60	42.00-45.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.075	....
In 5 Ton lots	lb.	....	.08
Less than 5 Tons	lb.	....	.085
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	8.50	8.50
Burnt (CaO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$) 16x120 mesh	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.00-14.00	....
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4)	ton	18.00-20.00	25.00
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb	.95	....
In barrels	Per 100 lb.	1.35	....
In bags	Per 100 lb.	1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	2.50-2.90
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.415	1.44
100 lb. bags		1.45	1.475

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.029	.03½
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.15	.15½-.16
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03	.03½
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.05½-.06	.06¼-.06½
Tin Oxide (SnO_2) in bbls.	lb.	....	.51
Titanium Oxide (ceramic grade)			
In bags	lb.	.12	.12¼-.12¾
In barrels	lb.	.12¼	.12½-.13
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06¼	.06½
White Seal, 150 lb. bbls.	lb.	.08¼	.09
Green Seal bags	lb.	.08	.08¼
Domestic White Seal bags	lb.	.08½	.08¾
Red Seal, bags	lb.	.07½	.07¾
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	.07-.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial. 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	.95-1.00
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green. 400 lb. bbls.	lb.	....	.22-.25
Chromite (99% through 200 mesh)	ton	40.00	44.50
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.165
Black (CuO)	lb.	....	.18-.19
Black prepared	lb.	....	.22
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.0425-.09
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls.	lb.	....	.135
Manganese, Black Oxide			
In Paper bags	ton	62.50	65.50
In Burlap bags	ton	64.25	67.25
In Casks	ton	66.50	69.50
Neodymium oxalate, 50 lb. drums	lb.	....	3.50
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.08¾	.09-.09¼
Powdered	lb.	....	.09½-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.19-.24
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08½	.08¾-.08⅞
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65.
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.75-1.80
Yellow	lb.	....	1.75-1.80
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.65-2.75
Yellow orange	lb.	....	1.75-1.80

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.063	.07
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	....	.03
0, 0½, ½, 1.	lb.	....	.04
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	....	.03½
Rouge, Red	lb.	....	.16
Black	lb.	....	.18

Announcement . . .

IN VIEW of rapidly increasing interest in LAKEFIELD NEPHELINE SYENITE by glass men everywhere, we wish to announce that both the American and Canadian Nepheline Companies, who produce Nepheline Syenite, and we who sell it, have made arrangements whereby we will transport visiting Ceramists to the quarry the week of the Meeting of the American Ceramic Society, in Toronto.

The huge Blue Mountain intrusion is not only of interest from the geological standpoint, but is of particular interest to the glass maker on account of its unusual chemical uniformity.

If you would like to visit this unique operation, please contact us at the meeting or, better yet, drop us a line and we will arrange for your transportation.

.001 loss

ONE glass container manufacturer has bought a total of 2700 Miller rings of Gunite. Only three of these 2700 Gunite neck rings were rejected due to faulty iron.

Performance such as this is responsible for the wide acceptance of Gunite Castings throughout the glass industry.

Write for details.

GUNITE FOUNDRIES CORPORATION
ROCKFORD, ILLINOIS
Established 1854

GLASS SPECIALTIES

Transparent Colored Blown Sheet Glass
Solid Pot Opal Blown Sheet Glass
Flashed Opal Blown Sheet Glass
Colonial Antique Colored Glass
Heat-Ray Resisting (Cool Glass)
"TWIN-RAY" — the scientific illuminating glass.

HOUZEX

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CONVEX GLASS CO.
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"IF IT'S MADE OF GLASS, ASK US FIRST"

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS

FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

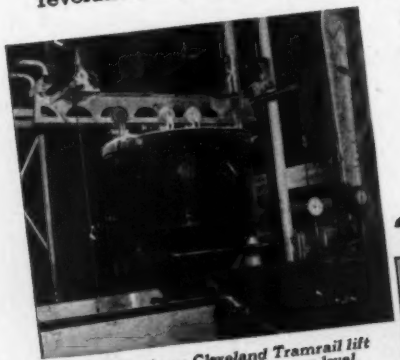
MODERNIZE
YOUR GLASS PLANT
WITH CLEVELAND TRAMRAIL

No Extensive Building Changes Necessary

Ask the management of any of the many glass plants that have modernized with Cleveland Tramrail if it is willing to return to its former method of handling and we know in each case the answer will be an emphatic, "No".

Cleveland Tramrail has played a prominent part in revolutionizing the methods of accumulation, mixing and conveying to the dog house. As a result glass manufacturing costs have been greatly reduced and profits increased.

Bucket Storage. Reserve buckets of mix are kept here until required at furnace. Cleveland Tramrail builds systems complete (including buckets) for manual or power-driven operation.

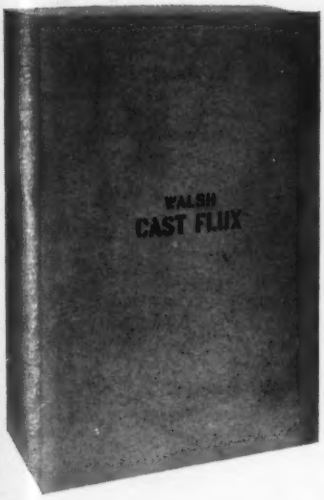


Bucket of mix on Cleveland Tramrail lift section midway up to dog house level.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1161 Depot Street Wickliffe, Ohio

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT
Other products: CLEVELAND CRANES and STEELWELD MACHINERY

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

Hit or miss methods of selecting soda ash, caustic potash and other alkalies you require for glass making have gone out of date.

Today, there are five important requirements to be considered when you place your order for an alkali . . .

QUALITY—Solvay Alkali quality is assured. The oldest and largest alkali producer . . . Solvay has established the quality standards of alkalies for years.

FORM OF PRODUCT—Many Solvay Alkalies are produced in various forms to meet your specific requirements.

UNIFORMITY—No hit or miss methods here—Solvay Alkalies are always as specified!

DISTRIBUTION—Three huge Solvay Plants in important industrial centers and many stock points assure efficient and on-time deliveries.

SERVICE—Do you have problems in alkalies? Solvay Technical and Engineering Service Division is maintained to help you.

SOLVAY DUSTLESS DENSE SODA ASH
More than 99.50% Sodium Carbonate *(on a dry basis.)*

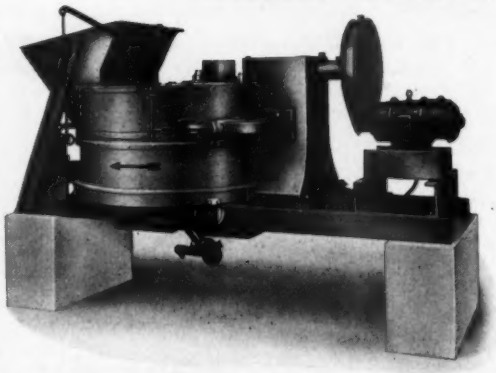
SOLVAY DUSTLESS CALCINED 98-100% POTASSIUM CARBONATE
Also Granular Hydrated 83-85%

SOLVAY GROUND CAUSTIC POTASH

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 RECTOR STREET NEW YORK, N. Y.
BRANCH SALES OFFICES:
Boston . Charlotte . Chicago . Cincinnati . Cleveland . Detroit
New Orleans . New York . Philadelphia . Pittsburgh . St. Louis . Syracuse

Lancaster Counter Current Rapid Batch Mixers

True Formula Development . . . A Matter of Course



Symbol EMC "Lancaster" Mixer, closed pan type with stationary hopper. Elevator hopper equipment also available.

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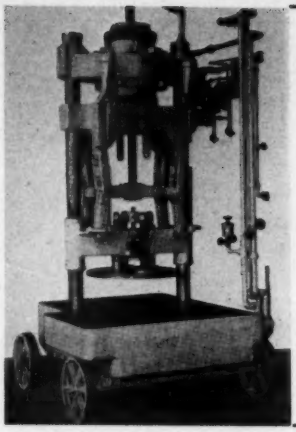

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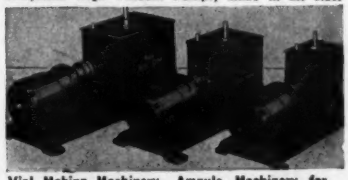

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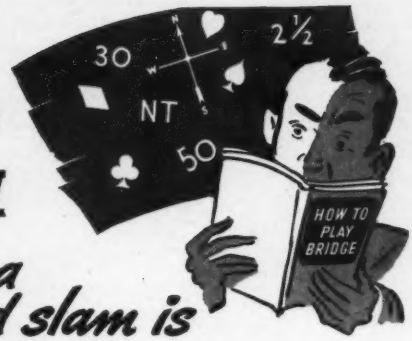

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